3710 Portable Samplers

Installation and Operation Guide

TELEDYNE ISCO
A Teledyne Technologies Company

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Foreword

This instruction manual is designed to help you gain a thorough understanding of the operation of the equipment. Teledyne Isco recommends that you read this manual completely before placing the equipment in service.

Although Teledyne Isco designs reliability into all equipment, there is always the possibility of a malfunction. This manual may help in diagnosing and repairing the malfunction.

If the problem persists, call or e-mail the Teledyne Isco Technical Service Department for assistance. Simple difficulties can often be diagnosed over the phone.

If it is necessary to return the equipment to the factory for service, please follow the shipping instructions provided by the Customer Service Department, including the use of the **Return Authorization Number** specified. **Be sure to include a note describing the malfunction.** This will aid in the prompt repair and return of the equipment.

Teledyne Isco welcomes suggestions that would improve the information presented in this manual or enhance the operation of the equipment itself.

Teledyne Isco is continually improving its products and reserves the right to change product specifications, replacement parts, schematics, and instructions without notice.

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General Warnings

Before installing, operating, or maintaining this equipment, it is imperative that all hazards and preventive measures are fully understood. While specific hazards may vary according to location and application, take heed in the following general warnings:

⚠ WARNING

This instrument has not been certified for use in "hazardous locations" as defined by the National Electrical Code.

⚠ WARNING

Avoid hazardous practices! If you use this instrument in any way not specified in this manual, the protection provided by the instrument may be impaired; this will increase your risk of injury.

⚠ AVERTISSEMENT

Éviter les usages périlleux! Si vous utilisez cet instrument d'une manière autre que celles qui sont specifiées dans ce manuel, la protection fournie de l'instrument peut être affaiblie; cela augmentera votre risque de blessure.

Additional safety information can be found in Appendix C.

Hazard Severity Levels

This manual applies *Hazard Severity Levels* to the safety alerts, These three levels are described in the sample alerts below.

⚠ CAUTION

Cautions identify a potential hazard, which if not avoided, may result in minor or moderate injury. This category can also warn you of unsafe practices, or conditions that may cause property damage.

⚠ WARNING

Warnings identify a potentially hazardous condition, which if not avoided, could result in death or serious injury.

⚠ DANGER

DANGER – limited to the most extreme situations to identify an imminent hazard, which if not avoided, will result in death or serious injury.

Hazard Symbols

The equipment and this manual use symbols used to warn of hazards. The symbols are explained below.

Hazard Symbols	
Warnings and Cautions	
	The exclamation point within the triangle is a warning sign alerting you of important instructions in the instrument's technical reference manual.
	The lightning flash and arrowhead within the triangle is a warning sign alerting you of "dangerous voltage" inside the product.
	Pinch point. These symbols warn you that your fingers or hands will be seriously injured if you place them between the moving parts of the mechanism near these symbols.
Symboles de sécurité	
	Ce symbole signale l'existence d'instructions importantes relatives au produit dans ce manuel.
	Ce symbole signale la présence d'un danger d'électocution.
	Risque de pincement. Ces symboles vous avertit que les mains ou les doigts seront blessés sérieusement si vous les mettez entre les éléments en mouvement du mécanisme près de ces symboles
Warnungen und Vorsichtshinweise	
	Das Ausrufezeichen in Dreieck ist ein Warnzeichen, das Sie darauf aufmerksam macht, daß wichtige Anleitungen zu diesem Handbuch gehören.
	Der gepfeilte Blitz im Dreieck ist ein Warnzeichen, das Sei vor "gefährlichen Spannungen" im Inneren des Produkts warnt.
	Vorsicht Quetschgefahr! Dieses Symbol warnt vor einer unmittelbar drohenden Verletzungsgefahr für Finger und Hände, wenn diese zwischen die beweglichen Teile des gekennzeichneten Gerätes geraten.

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3710 Portable Samplers

Section 1 Introduction

The 3710 Portable Sampler is a programmable liquid sampler designed for composite sampling. It is one of Teledyne Isco's 3710 Series of portable and refrigerated samplers. The extensive sampling capabilities, flexible programming, and durable construction make the 3710 Sampler ideally suited for general purpose or priority pollutant sampling.

The 3710 Sampler, although easy to use, offers a number of very sophisticated features. The following sections introduce key features and provide an overview of the unit's sampling capabilities and a variety of interfacing equipment. Examples of interfacing equipment include Isco Flow meters for flow proportional sampling and sampler enable control and laptop computers which collect and store the same data. A brief discussion of this interfacing equipment is placed at the end of this section.

1.1 Description

The 3710 Portable Samplers in the standard and compact configurations are designed to be operated in hostile environments, such as sanitary sewers, without additional protection. The acrylonitrile-butadiene-styrene (ABS) plastic used in the basic construction of the exterior exhibits good resistance to aqueous solutions containing common acids and bases. All other external components are made of either stainless steel, anodized aluminum, polypropylene, or Noryl™.

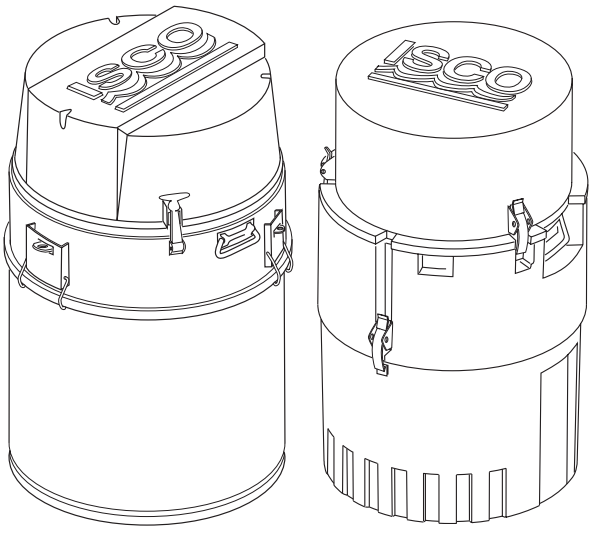


Figure 1-1 Standard and Compact Samplers

Both of the 3710 Portable Sampler configurations consist of three units: the top cover, the center section, and the base section. The removable top cover protects the control box mounted on the center section. The center section includes the control box, liquid detector, and pump. It also supports the shut-off float cage assembly used to automatically terminate sampling when the sample container becomes full. The base section holds the composite sample bottle and is fully insulated, allowing you to ice down samples to maintain sample integrity.

The compact sampler has the same sampling capabilities, flexible programming, and rugged construction of the standard sampler, but is also lightweight and can fit down circular manholes as small as 18 inches in diameter.

The controller is housed in the watertight control box mounted on the top of the center section. The controller consists of a microprocessor with software embedded in a PROM (Programmable Read Only Memory) and supporting electronics. A desiccator is installed in the control box to prevent moisture damage to the electronics and pump.

The controller runs the pump, responds to the keypad, and presents information on the display. It governs all automatic sampling according to user-selectable program settings. The controller also provides for manual control of the sampler; for instance, you can run the pump forward with the PUMP FORWARD key or initiate a manual sample with the MANUAL SAMPLE key.

The control panel, containing the 40 character alphanumeric LCD (Liquid Crystal Display) and keypad, is located on the top of the control box. The 23 position keypad is used to enter program parameters and direct the following controls: on/off, pump reverse, pump forward, stop the pump, start sampling, resume sampling, and display the operating status.

1.2 Programmable Features

An intuitive user interface allows the 3710 Sampler to be programmed for both simple and complex sampling schemes. The LCD prompts you through the programming process by presenting a choice or a question on the sampler's LCD. Programming the sampler is a matter of responding to displayed prompts with the keypad. Two programming modes, "basic" and "extended," are standard with the 3710 Sampler. The basic programming mode allows you to set up typical sampling routines easily and efficiently. The extended programming mode expands the versatility of the sampler by providing options which allow you to create complex sampling routines.

The LCD not only prompts you through the programming process, but also allows you to closely monitor a sampling routine as it is executed. The LCD displays pertinent information about the routine – for example, the time of the next sample – and notifies you of any problems encountered during the routine. As the routine progresses, the sampler logs key information about the results of the routine. The results include the start time, any halt and resume times, time of samples, and cause of any missed samples. This information is accessible during a routine or after

a sampling routine is finished. You can view this information from the sampler's display or retrieve it with the Field Printer or a laptop computer running Teledyne Isco's Samplink software.

1.2.1 Flexible Sample Intervals

The 3710 is designed for composite sampling. Samples may be collected at user-definable time intervals (time-pacing) or at equal flow volume intervals using flow pulse inputs from an external flow meter (flow-pacing). The flow interval may be set from 1 to 9999 flow pulses. Sampling can be terminated by a float shut-off mechanism or by a user-defined number of samples.

The sampler offers two types of time-pacing: uniform and non-uniform. Uniform time-paced samples may be taken at regular time intervals, a sample every 15 minutes, for example. The interval between samples can be set from 1 minute to 99 hours, 59 minutes in 1 minute intervals. Using the extended programming mode, you can specify up to 999 (or bottle volume dependent) non-uniform time intervals in minutes. For example, you can program the sampler to take the first six samples at 10 minutes intervals, then four more samples at 15 minute intervals, and so on. Non-uniform time intervals can be from 1 to 999 minutes in 1 minute intervals. Nonuniform times can be specified in a clock-time format by entering a time and date for each sample. The sampler will accept up to 99 nonuniform clock times.

Additionally, the Sampling Stops and Resumes feature allows you to create an intermittent sampling schedule. With this extended programming feature, you can sample only during key periods of the day. For example, you may wish to sample only during the hours of 6:00 a.m. to 8:00 a.m., and 5:00 p.m. to 7:00 p.m. You can enter up to 12 sampling stops and 12 resumes. Sampling stops and resumes can be used with both flow- and time-paced routines and with uniform and nonuniform time intervals.

1.2.2 Accurate Sample Volumes

The sampler can be programmed to take sample volumes of 10 to 9990 milliliters. Equipped with the patented LD90 liquid presence detector, the 3710 Sampler delivers accurate, repeatable sample volumes in changing head conditions. The LD90 is a *non-wetted* liquid presence detector. It detects virtually any pumpable liquid and because it is non-wetted; sample conductivity, viscosity, temperature, and composition do not affect detection. Although it is not normally necessary, sample volumes can be calibrated, if desired.

1.2.3 Flexible Start Times

A sampling routine can be programmed to use a specific start time and date or a start time delay. The sampler will accept a specific start time and date up to one month in advance of the current date. The start time delay is the period between the time you press the START SAMPLING key and the time the routine actually starts. It is adjustable from zero to 9999 minutes.

1.2.4 Master/Slave Sampling

A notable feature is the Master/Slave setting which allows you to operate two 3710 Samplers as a master/slave pair. Master/Slave sampler pairing allows you to double the capacity of a sampling installation and to perform continuous sampling routines. Two samplers can be connected so that one sampler (the master) inhibits the operation of the second sampler (the slave) until the master completes its sampling routine. At that time, the samplers reverse roles. A full sampler can be serviced while its counterpart is running a routine. In some applications, master/slave pairs can reduce the number of visits to an installation. Reducing the number of visits is important when the costs and safety of a sampling study are considered.

Other features are available. Program storage allows you to store up to three separate programs, eliminating the need to reprogram the sampler for recurrent sampling routines. A program lock is available for protection from unauthorized program alterations. When enabled, a password must be entered before any program settings can be changed, although program settings can be viewed at any time.

1.2.5 Foreign Languages and Metric Units of Measure

The 3710 Sampler provides displays in French, German, and Spanish. Additionally, the software supports entries in metric units of measure. Samplers using French and German language displays support metric units for suction line and suction head measurements. Metric units include volumes in milliliters, suction head and suction line length in decimeters, and suction line inside diameter (ID) in millimeters. Samplers operating with English displays support either English or metric units for suction line and suction head measurements. (Sample volume units are always entered in milliliters, regardless of the selected language.)

1.3 Delivery System

The 3710 Sampler uses a peristaltic pump for sample collection. The sample liquid is under pumped flow at all times; there are no metering chambers or gravity-fed internal tubing. Each sampling cycle includes an air pre-sample purge and a post-sample purge to clear the suction line both before and after sampling. These features make the 3710 Sampler ideal for both “suspended solids” and “toxic materials” sampling. Cross contamination between samples is minimized and sites for sediment accumulation in the system are eliminated. Materials in contact with the sample fluid are limited to the strainer, suction line, pump tubing, and collection bottles. The system can be easily and safely cleaned by simply replacing relatively inexpensive lengths of tubing.

Pump speed is approximately 250 RPM which generates a velocity sufficient to obtain representative samples. The pumping rate of 3500 ml per minute is generated when using $^{3}/_{8}$-inch ID suction line at 3 ft of head. The line transport velocity, using the same suction line and head, is 2.9 ft per sec. Volumetric accuracy is not significantly affected by pump speed since the delivered volume is based on a patented electronic count of the number of pump revolutions.

1.3.1 Liquid Detector

The LD90 gives the 3710 Sampler the ability to deliver accurate, repeatable sample volumes regardless of changing head conditions. Typical sample volumes are accurate to within 10% of the programmed volume and repeatable to within ± 10 ml. The detector and a programmable setting provide for automatic rinsing of the suction line when concerns of cross contamination arise. A programmable setting for sampling retries is available. If the suction line becomes clogged and no liquid is detected in the line, the sampler can be programmed to repeat a purge cycle – up to three times – to clear the clogged line.

1.3.2 Pump Tubing and Suction Lines

The pump tubing is Silastic™ medical grade silicon rubber. Liquid is transferred from the source to the pump through either ¼- or ⅜-inch ID vinyl or ⅜-inch ID PTFE suction tubing.

The pump tubing and suction lines are easily replaced, minimizing the need for cleaning. The sampler automatically monitors pump tubing wear: a tubing warning indication is reported on the display when the pump revolution count exceeds a user-specified wear limit.

1.3.3 Float Shut-Off

The pump tube is routed from the pump, through a port in the center section, to a float cage on the interior of the center section. The float cage assembly serves to position the discharge of the pump tube into the container. It also provides a sampling fail-safe shut-off in case the container is accidentally overfilled.

1.3.4 Strainers

The ⅜ inch ID vinyl suction lines are shipped from the factory with our standard weighted polypropylene strainer installed on one end of the suction line and a tubing coupling on the other end.

Additionally, Teledyne Isco offers two low flow stainless steel strainers for ¼ inch ID and ⅜ inch ID suction lines.

For sampling from highly acidic flow streams, a weighted plastic CPVC strainer is available.

1.3.5 Standard Sampler Bottle Configurations

Three sample containers are available: a 9400 ml (2.5 gallon) glass container with PTFE lined caps, a 9400 ml (2.5 gallon) polyethylene sample container with unlined caps, or a 15,000 ml (4 gallon) polyethylene container with unlined caps. The 2.5 gallon containers require a locating insert to correctly position the containers within the base.

1.3.6 Compact Sampler Bottle Configurations

Two sample containers are available for the compact sampler: a 9400 ml (2.5 gallon) glass container with PTFE lined caps, or a 9400 ml (2.5 gallon) polyethylene sample container with unlined caps. The containers fit directly into the compact base.

1.4 Power Sources

The sampler is powered by a 12 VDC power source. A rechargeable nickel-cadmium battery is most commonly used; however, lead acid batteries are available. The Teledyne Isco Nickel-Cadmium battery has an operating capacity of seven standard sampling programs after an 18 hour charge. (A standard sampling program is defined to be 24 samples at a rate of one 200 ml sample per hour, using 10 feet of 3/8-inch vinyl suction line at a 5 ft head.) The Teledyne Isco Lead-Acid Battery has an operating capacity of eleven standard sampling programs. The sampler may also be powered by an Isco 120 VAC 50/60 Hz or 240 VAC 50/60 Hz Power Pack. Both power packs may also be used to recharge the Teledyne Isco batteries. A 3V lithium battery, with a minimum service life of 5 years, maintains the controller's real time clock and program settings when power is disconnected.

1.5 Interfacing Equipment

A full line of accessories and interfacing equipment is available to help you adapt the sampler to your specific application; some of the more common items are briefly noted below. Other key accessories are noted throughout this manual, where appropriate. A full list of accessories is found in Appendix B.

1.5.1 Isco Flow Meters

The 4200 Series Flow Meters, 2100 Series Flow Modules, and 4100 Series Flow Loggers, and UniMag Closed-Pipe Flow Meters, are collectively called "flow meters" in this manual. The 3710 Sampler will accept flow pulses from all Isco Flow meters for flow-paced sampling. These include the 4200 Series Flow Meters, 2100 Series Flow Modules, and 4100 Series Flow Loggers, which this manual collectively calls "flow meters." Isco Flow meters, with the exception of the 2100 modules, are equipped with a sampler enable feature. Isco Flow meters can inhibit a 3710 Sampler until the level of the flow stream reaches a predetermined height or "set point"; when that height is reached, the flow meter enables the sampler and starts the sampling routine. If the level of the stream falls below the set point, the flow meter can disable the sampler and halt the routine.

When equipped with a rain gauge, the 4200 Series Flow Meters and 4100 Series Flow Loggers can monitor rainfall. The flow meter can be programmed to enable the sampler when the measured amount of rainfall reaches a predetermined set point.

Set points or pairs of set points — pairs can be level and rainfall rates, level and elapsed time, rainfall and elapsed time, and so on — form the *sampler enable control condition*. A control condition is simply the set of parameters defining the conditions in which a flow meter will enable the sampler. For example, a flow meter can be programmed with a control condition which is satisfied when the flow meter detects ¼-inch of rainfall in 15 minutes. While level control conditions can be entered directly at the flow meter front panel, most control conditions must be downloaded to the flow meter from an IBM compatible computer running Teledyne Isco's Flowlink software.

In addition to enable control conditions, Teledyne Isco's Flow Meters provide an internal memory module. When programmed with the Flowlink software, the flow meters store level or flow rate readings, rainfall measurements, and sample event data from the samplers. The stored data, which expands the information available from the sampler's results displays, can be retrieved with a computer running the Flowlink software. For more information on sampler enable control conditions and data retrieval, refer to the Flowlink Help files.

The 3710 Sampler sends event marks to Isco Flow meters each time a sample is taken. This information is recorded by the flow meter. The event mark can be adjusted according to the type of flow meter used.

1.5.2 Non-Isco Flow Meters

You can connect certain non-Isco Flow meters directly to a 3700 for flow-paced sampling. The flow meter must have an isolated contact closure of at least 25 milliseconds to provide acceptable flow pulses to the sampler. The frequency of the contact closure must be directly proportional to total flow.

If the flow signal is not compatible with Teledyne Isco's standard, Teledyne Isco offers special interfacing devices. See Sections 4.2.2 and 4.2.3.

1.5.3 Samplink for Sample Data Retrieval

Samplink is designed to run on a laptop computer which can be taken to the sampling installation to collect the data. Samplink collects the data and formats it into two files: a text file and a Flowlink-compatible sample event file. The text file can be loaded into a word processor for editing. Samplink's text file contains the same two reports produced by the Field Printer. The first report contains sampler status information and program settings. The second report contains the sampling results. Because the text file is preformatted into report form, you can use DOS printing commands to print the file without editing with a word processor.

> ☑ ***Note***
>
> The Field Printer has been discontinued and is no longer sold by Teledyne Isco.

1.5.4 Liquid Level Actuator

The Liquid Level Actuator is used to provide level-sensitive control of the sampler. The actuator can be used as a simplified alternative to a flow meter.

1.5.5 Master/Slave Cables

Master/Slave Interconnect Cable – Connects two 3710 Samplers as master and slave.

3710 Master/Slave to Flow Meter Cable – Connects two 3710 Samplers as master and slave and connects the pair to an open-channel flow meter.

1.6 Technical Specifications

Technical specifications for the 3710 Standard and Compact Samplers can be found in the following table.

Table 1-1 3710 Sampler Technical Specifications

Physical Specifications: Standard Sampler	
Physical Size	Height: 28.75 in (73.3 cm) Diameter: 19.25 in (48.9 cm)
Dry Weight	32 lbs (14.5 kg) with polypropylene bottles
Operational Temperature Range	32° to 120° F (0° to 50° C)
Storage Temperature Range	0° to 140° F (-20° to 60° C)
Control Box	Self Certified NEMA 4X and 6 ratings (Submersible, watertight, dust-tight, and corrosion resistant)
Sampler Base Capacity	One 2.5 gallon (9400 ml) glass or polyethylene container or one, 4 gallon (15000 ml) polyethylene container
Base Insulation	Standard thermal resistance factor of R-14
Physical Specifications: Compact Sampler	
Physical Size	Height: 27.6 in (70.1 cm) Diameter: 17.75 in (45.1 cm)
Dry Weight	32 lbs (14.6 kg) with a 2.5 gal polyethylene bottle
Operational Temperature Range	32° to 120° F (0° to 50° C)
Storage Temperature Range	0° to 140° F (-20° to 60° C)
Control Box	Self Certified NEMA 4X and 6 ratings (Submersible, watertight, dust-tight, and corrosion resistant)
Sampler Base Capacity	One 2.5 gallon (9400 ml) glass or polyethylene container
Base Insulation	Standard thermal resistance factor of R-11
Power Specifications	
Sampler Power Requirement	12 VDC supplied by battery or AC power converter Sampler standby current 10 mA, maximum
External Teledyne Isco Nickel-Cadmium Battery Capacity	7 standard sampling programs (24 samples at a rate of one 200 ml sample per hour, using 10 ft of 3/8-inch vinyl suction line at a 5 ft head)
External Teledyne Isco Lead Acid Battery Capacity	11 standard sampling programs (24 samples at a rate of one 200 ml sample per hour, using 10 ft of 3/8-inch vinyl suction line at a 5 ft head)
Controller Internal 3V Lithium Battery Capacity	5 years, minimum (maintains internal logic and program settings.
Pump and Tubing Specifications	
Suction Tubing (intake)	3 to 99 foot lengths of: 1/4-inch ID vinyl 3/8-inch ID vinyl 3/8-inch ID PTFE lined
Suction Lift	26 feet (7.9 m), maximum

Table 1-1 3710 Sampler Technical Specifications (Continued)	
Pumping Rate (at 3 feet of head)	1/4-inch ID suction tubing: 3000 ml/minute 3/8-inch ID suction tubing: 3500 ml/minute
Line Transport Velocity (at 3 feet of head)	1/4-inch ID suction tubing: 5.1 ft/sec 3/8-inch ID suction tubing: 2.9 ft/sec
Clock Specifications	
Real Time Clock Accuracy	1 minute/month, typical
Sample Specifications	
Sample Volume Accuracy	With the liquid detector enabled and automatic compensation for head: typically, the greater of ± 10% or ± 20 ml, over a head range of 1 to 12 feet and sampler supply voltage of 10 to 13 volts.
Sample Volume Repeatability	± 10 ml, typical
Sample Frequency	Selectable from one minute to 99 hours, 59 minutes in 1 minute increments between consecutive samples, or from 1 to 9999 flow pulses in single pulse intervals. Up to 999 nonuniform times may be entered in minute intervals or up to 99 times as specific clock times.
Flow Meter Signal Specifications	
Flow Meter Signal Requirements	5 to 15 volt DC pulse or isolated contact closure of at least 25 milliseconds duration. (A 4-20 mA or pulse duration signal may be converted with optional interface unit.)

☑ *Note*

If you should experience interference with radio or television reception while using this equipment, try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna on the television
- Relocate the unit with respect to the receiver
- Plug the unit into a different outlet so the unit and receiver are on different branch circuits
- If necessary, consult the manufacturer or an experienced radio-television technician for additional suggestions.

You may find the following booklet prepared by the FCC helpful: "*How to Identify and Resolve Radio-TV Interference Problems*." This book is available from the U.S. Government printing Office, Washington, D.C. 20402, Stock No. 004-00-0035404.

3710 Portable Samplers

Section 2 Setup Procedures

To place the sampler into operation, the base section must be prepared, the suction line attached, a power source connected, the sampler placed at the sampling site, the suction line inlet properly placed in the liquid source, and an external flow meter (if used) interfaced with the sampler. The sampler can be programmed on site or in the office. Guidelines for programming the sampler can be found in Section 3.

2.1 Case Assembly and Disassembly

Disassemble the case by separating the cover and base from the center section. Refer to Figure 2-1 for the standard sampler and Figure 2-2 for the compact sampler.

2.1.1 Standard Samplers

To remove the cover, unlatch the three black rubber draw catches and lift the cover off. To gain access to the base section, unlatch the three lower stainless steel latches and lift the center section straight up. Reassemble the case by reversing this procedure.

2.1.2 Compact Samplers

To separate the sections, unlatch the stainless steel latches and lift the sections straight up. Reassemble the case by reversing this procedure. Note that each piece is keyed and will lock into place when it is aligned correctly.

2.2 Preparing the Base Section

The standard sampler base section will hold either a 2.5 gallon or 4 gallon composite container. Both the 2.5 gallon glass and 2.5 polyethylene containers require a locating deck to correctly position them in the base. (Both 2.5 gallon bottles use the same deck.) The 4 gallon polyethylene container does not require the locating deck; it can be installed by placing it directly into the base.

The compact base section will hold either a 2.5 gallon glass, or a 2.5 gallon polyethylene bottle. These containers fit directly into the base.

Figure 2-3 diagrams the location of the bottles in the standard and compact configurations.

The sampler is shipped from the factory with the sample bottle in place. For first time use, the only preparation necessary will be to remove the bottle cap. For subsequent uses, place a new or cleaned bottle in the base as shown in Figure 2-3.

2.3 Cooling the Samples

The samples may be cooled by placing cubed or crushed ice in the base section after installing the sample container, creating an ice bath. The quantity of ice used is dependent upon the required sample temperature and the ambient temperature of the sampling site. The capacity of the standard base is approximately 20

pounds of cubed ice when the 4 gallon container is used. The capacity of the compact base is about 12 pounds of cubed ice when the 2.5 gallon polyethylene bottle is used.

> ☑ ***Note***
>
> When cooling the samples with ice, the melt water may cause the bottle to float when you remove the center section.

Insulation – The standard center section and base section have double-walled construction with polyurethane foam insulation. The insulation has a standard thermal resistance factor of R-14. A fully assembled compact sampler has an average thermal resistance factor of R-11.

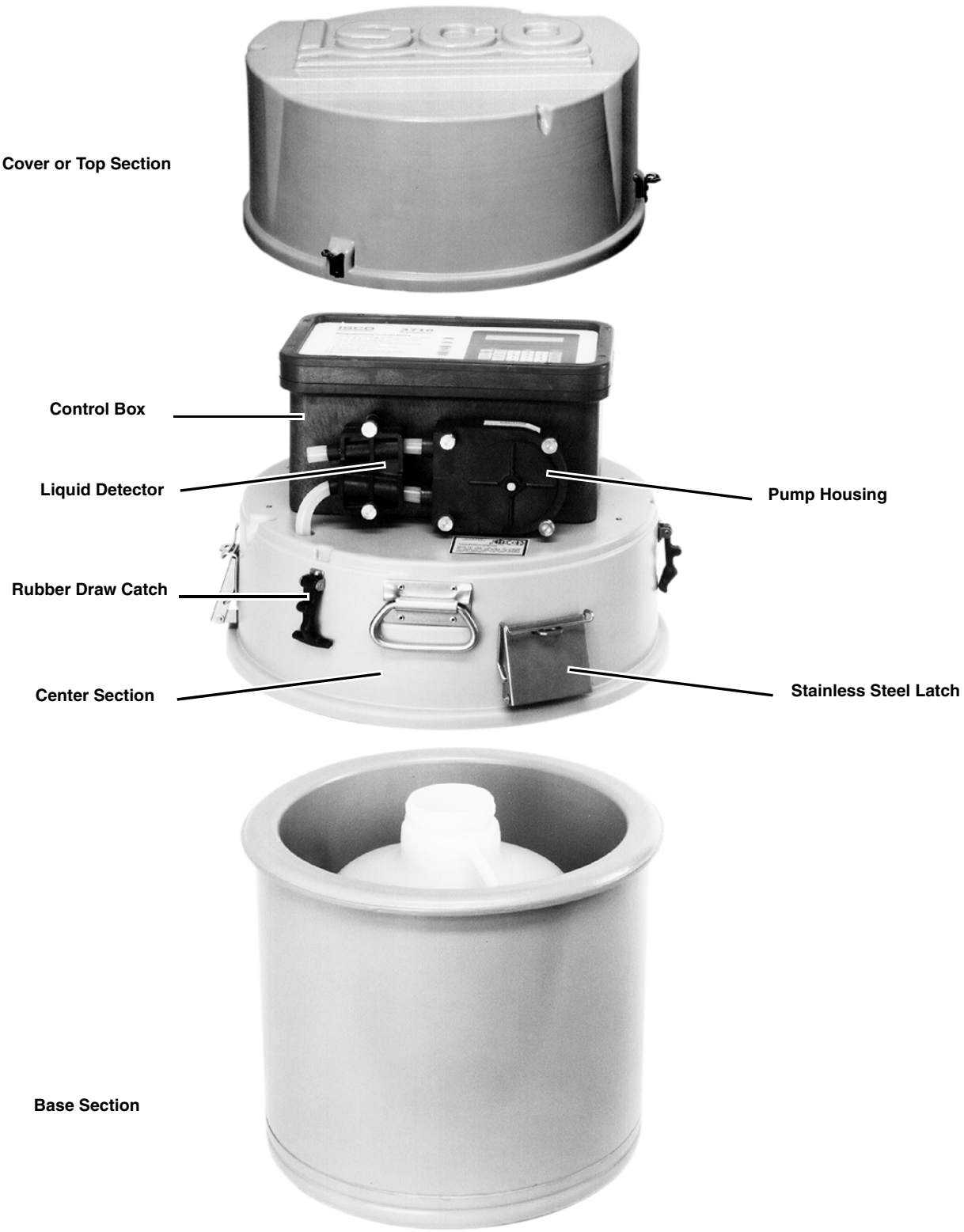


Figure 2-1 Disassembled Sampler, Standard

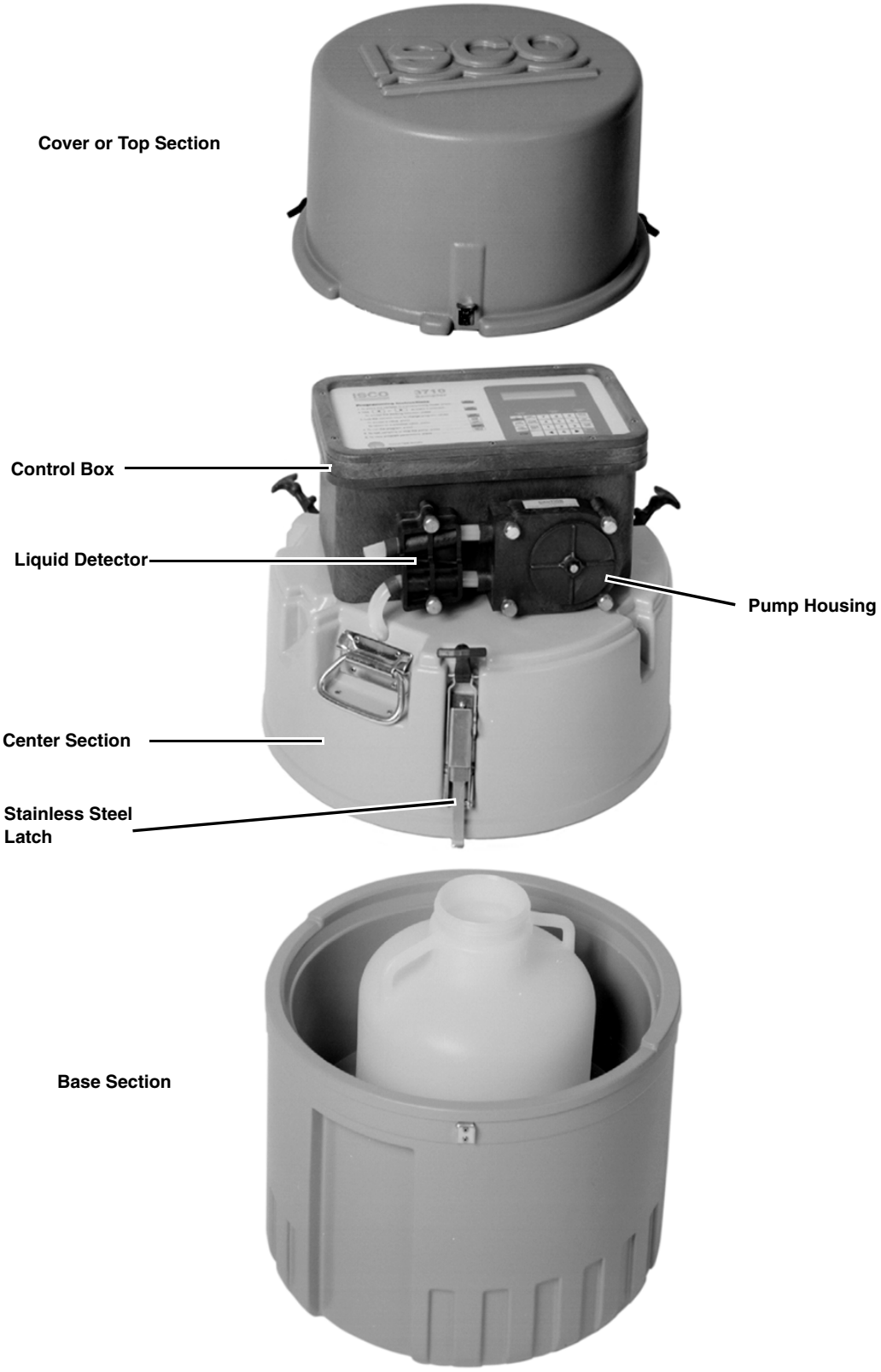


Figure 2-2 Disassembled Sampler, Compact

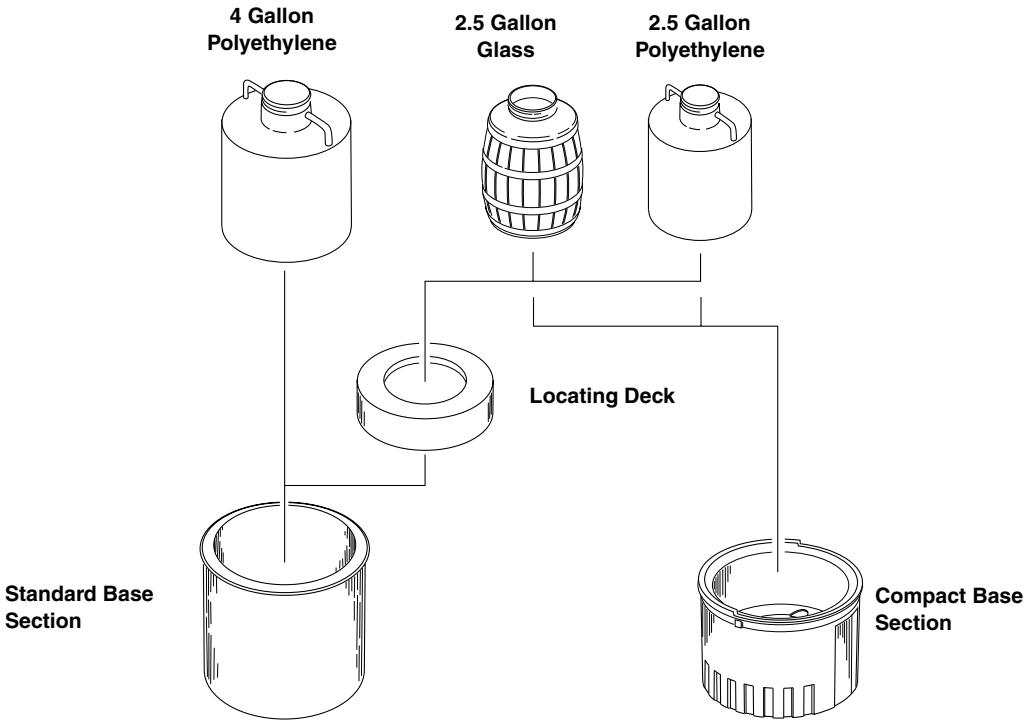


Figure 2-3 Location of Containers in the Base Section

2.4 Suction Line

The suction line is the piece of tubing that extends from the sampler's pump tubing intake, at the top of the liquid detector, to the liquid source. There are three standard suction lines available: plasticized vinyl tubing in 1/4-inch (0.64 cm) or 3/8-inch (0.94 cm) inside diameters, or FEP PTFE with a polyethylene cover in 3/8-inch inside diameter. The polyethylene cover over the 0.02 inch (0.051 cm) wall PTFE line prevents the PTFE liner from kinking or collapsing in service and protects it from abrasion and other damage.

The vinyl suction line contains a very low PPM (parts per million) level of phenols. If this affects your samples, use the PTFE suction line.

Both vinyl and PTFE lines can be cut to any length from 3 to 99 feet in 1 foot increments. Cut the suction line in whole foot increments: lengths of 4 ft, not 3.5 ft. The controller will accept only whole numbers as suction line lengths. To insure the accuracy of the sampler, the suction line length entered must equal that of the actual line measurement. When programming the sampler, you must enter the inside diameter, type, and length of suction line used.

Cut the line to the shortest length feasible: this aids the downhill routing. Avoid loops of coiled suction line which may hold residual amounts of liquid which would cross contaminate sample volumes. A shorter suction line will also extend battery life and pump tube life because a shorter pumping cycle will be needed to deliver the sample volume.

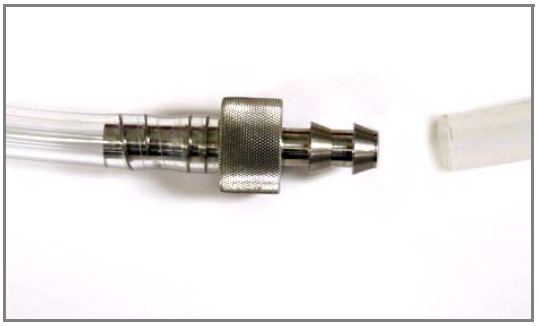
Although the suction line can extend to a liquid source up to 99 feet from the sampler, note that the maximum lift for the peristaltic pump with either the PTFE or vinyl line is 26 feet. When installing the sampler, be sure the head — the vertical distance between the level of the liquid source and the pump — is no greater than 26 feet. The pump will not be able to deliver samples for heads of 26 feet or greater.

2.4.1 Attaching Vinyl Suction Line

Attach vinyl suction line to the pump tubing with the tube coupling. Two couplings are available, one for each size of vinyl line.

Attach the vinyl suction line to the pump tube with the tubing coupler. First, screw the threaded end into the suction line until the flat surface is flush against the suction line (Figure 2-4). Then, push the other end of the coupler into the end of the pump tube until the other flat surface is flush against the tubing.

1.



2.

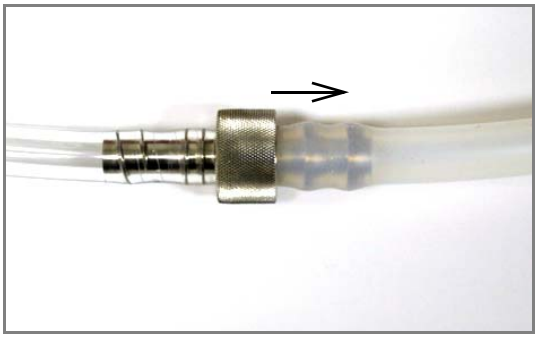


Figure 2-4 Attaching the suction line to the pump tubing

Once the coupler is attached to the pump tube, removal is difficult, and may require cutting the tube.

2.4.2 Attaching the PTFE Suction Line

The PTFE line is attached to the pump tubing by inserting the line into the pump tubing and securing it with a suitable clamp.

2.4.3 Routing of the Suction Line

Route the line from sampler to sampling point so that it is continuously sloped downhill. This helps to drain the suction line when the peristaltic pump reverses to purge the line and minimizes

the possibility of cross contamination. When the sampler is used in near freezing temperatures, thoroughly draining the suction line minimizes the possibility of frozen liquid clogging the line.

2.5 Strainers

The 3/8 inch ID vinyl suction lines are shipped from the factory with our standard weighted polypropylene strainer (Figure 2-5) installed on one end of the suction line and a tubing coupling on the other end.

Additionally, Teledyne Isco offers two low flow stainless steel strainers (Figure 2-6) for 1/4 inch ID and 3/8 inch ID suction lines.

For sampling from highly acidic flow streams, a weighted, CPVC plastic-coated strainer is available (Figure 2-7).

The use of the strainer is optional. When heavy suspended solids are involved and flow stream velocities are significant, some field investigation results indicate that more representative samples are obtained without the strainer.

You can purchase bulk suction line without strainers. Refer to the *Accessories List* in the back of this manual. The strainer prevents solid particles larger than a specific diameter from entering and clogging the suction line. Teledyne Isco recommends its use for bottom sampling or sampling from streams containing large solids. The 1/4-inch strainers supplied for use with the 1/4-inch ID suction line have 15/64-inch (0.56 cm) diameter holes. The 3/8-inch strainers supplied for use with the vinyl or PTFE 3/8-inch ID suction line have 23/64-inch (0.9 cm) diameter holes.

2.5.1 Intake Placement

The proper placement of the sampler intake assures the collection of representative samples. Place the intake in the main flow, not in an eddy or at the edge of flow. The vertical position of the intake in the flow is important. An intake at the bottom may result in excess heavy solids and no floating materials, while placement at the top may result in the opposite.

The suction line tends to float in deep flow streams, dislodging the line and strainer. The following chart shows the maximum depths you can submerge the lines and strainers without risks of flotation. At depths exceeding the safe depths, anchor the line and strainer securely.

Table 2-1 Strainers

Strainer	Vinyl 1/4-inch (6 mm)	Vinyl 3/8-inch (9 mm)	PTFE 3/8-inch (9 mm)
Standard Weighted Polypropylene	—	22 feet (6.7 m)	15 feet (4.5 m)
Stainless Steel Low Flow	14 feet (4.3 m)	22 feet (6.7 m)	15 feet (4.5 m)
CPVC	—	4 feet (1.2 m)	4 feet (1.2 m)

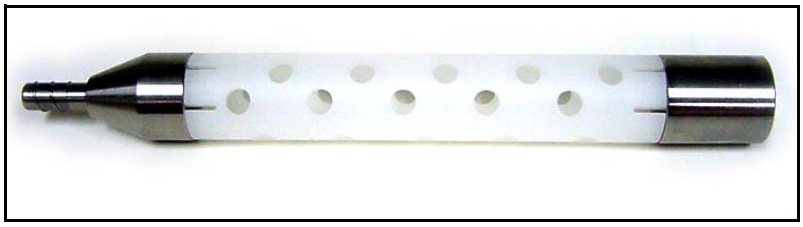


Figure 2-5 Standard Weighted Polypropylene Strainer

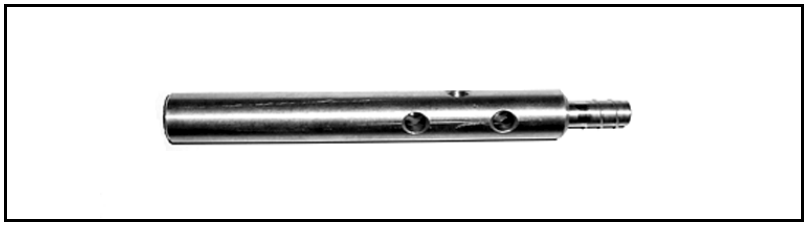


Figure 2-6 Stainless Steel Strainer

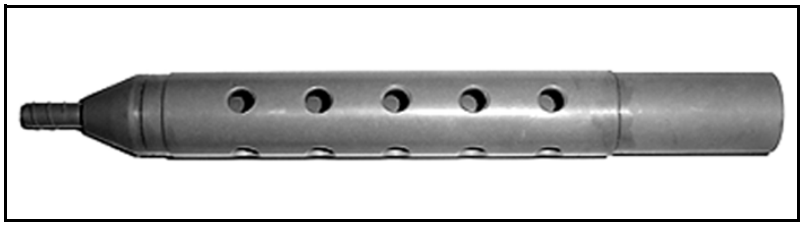


Figure 2-7 CPVC Weighted Strainer

If the strainer is not used, a short piece of thin walled aluminum tubing may be attached to the end of the suction line and the tubing anchored in the flow stream so that the inlet is oriented upstream. The thin wall will provide minimum disturbance of the flow stream and aluminum ions are usually not of concern in analysis. Whether the strainer is used or not, the pre-sample purge cycle should be sufficient to remove any debris which may collect over the strainer or tubing entrance between sampling events.

2.6 Connection to Power Source

The 3710 Sampler must be supplied with 12 VDC power from an Isco power source. Figures 2-8 through 2-10 show batteries and a power pack mounted on the sampler. Information about recharging the batteries as well as additional information about Teledyne Isco's power sources is in the Teledyne Isco *Power Products Guide*.

2.6.1 Internal Battery

The internal 3 V lithium battery keeps the sampler's electronic logic and timing circuitry operative and maintains the sampler's program when the unit is shut off or external power is disconnected. This battery will not operate the sampler pump.

2.6.2 Mounting Power Sources

Place the unit in the recess provided in the center section; orient the power source cables as shown in Figures 2-8 through 2-10. Then attach the two black rubber draw catches to their mating receptacles by stretching the catches up and into the "U" shaped receptacles. Finally, attach the power-source connector to the "12 VDC" connector on the side of the sampler control box. If mounting an AC Power Pack, route the line cord through the external line port notch in the center section.

2.6.3 External 12 Volt Direct Current Source

The 3710 Sampler may be powered with an external 12 volt direct current source, such as a 12 VDC automotive or marine battery. A deep cycle RV or marine battery is well suited for this application. An optional connect cable, terminating in battery clips, connects the sampler to the battery. See Appendix B.

If an external battery is used, plug the connector on the end of the external battery connect cable into the "12 VDC" connector on the side of the sampler. Then, connect the positive and negative leads on the free end of the cable to the positive and negative terminals of the 12 VDC source. The positive lead of the cable is painted red and has a plus sign, "+," stamped in it. The cable should pass through the external line port. The line port is shown in Figure 2-8.

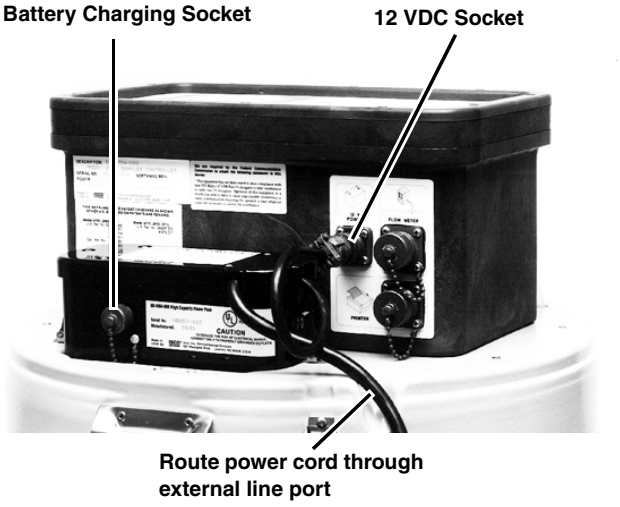


Figure 2-8 Connecting the AC Power Pack

Figure 2-9 Connecting a Nickel-Cadmium Battery

Figure 2-10 Connecting a Lead-Acid Battery

2.7 Placement of the Sampler

The sampler should be placed in a relatively level position. Placing the sampler on a steep incline may cause the it to tip over as the bottle is filled.

The standard sampler is designed to fit through a circular manhole opening as small as 20 inches (51 cm) in diameter. The compact sampler can fit into circular manholes with a diameter as small as 18 inches (46 cm).

A stainless steel cable harness is available as an option for lowering or raising the unit through a manhole. The unit may also be suspended from the same harness during operation, as shown in Figure 2-11. If it is necessary to enter the manhole, observe all safety precautions. Refer to Appendix C for a discussion of safety considerations.

Although the suction line can extend to a liquid source up to 99 feet from the sampler, note that the maximum lift for the peristaltic pump with either the PTFE or vinyl line is 26 feet. When installing the sampler, be sure the head — the vertical distance

between the level of the liquid source and the pump — is no greater than 26 feet. The pump will not be able to deliver samples for heads of 26 feet or greater.

2.8 Connection to a Flow Meter

Connecting the sampler to Teledyne Isco and non-Isco Flow meters is discussed in Section 4. If a connect cable is not attached to the flow meter connector on the side of the sampler, be sure that the protective cover is tightly screwed in place to maintain the watertightness of the unit.

2.9 Placing the Sampler into Operation

The sampler may be programmed for automatic operation as described in Section 3. Because the lithium battery maintains the program settings while the sampler is turned off, the sampler may be easily programmed in the office or the lab, taken into the field, and then placed into operation. The sampling program is started by pressing the START SAMPLING key, located on the control panel.

2.10 Sample Recovery

The sampler will automatically cease operation after the programmed number of samples have been placed in the container or sampling has been stopped by the float shut-off. When the sampling routine has finished, the display will read “DONE” or “FLOAT/WEIGHT TRIPPED.”

2.10.1 Recovering the Sampler

When recovering the sampler, keep it level to prevent spilling the collected liquid. If the entire sampler is to be returned to the laboratory or office, disconnect the cable from the flow meter, if used. The sampler may be turned off, but this is not necessary. Separate the base section from the center section, as described in Section 2.1, and install the cap on the bottle. The sampler is now ready to transport.

> ☑ ***Note***
>
> Disassemble the case carefully. When cooling the samples with ice, the melt water may cause the bottle to float when you remove the center section.

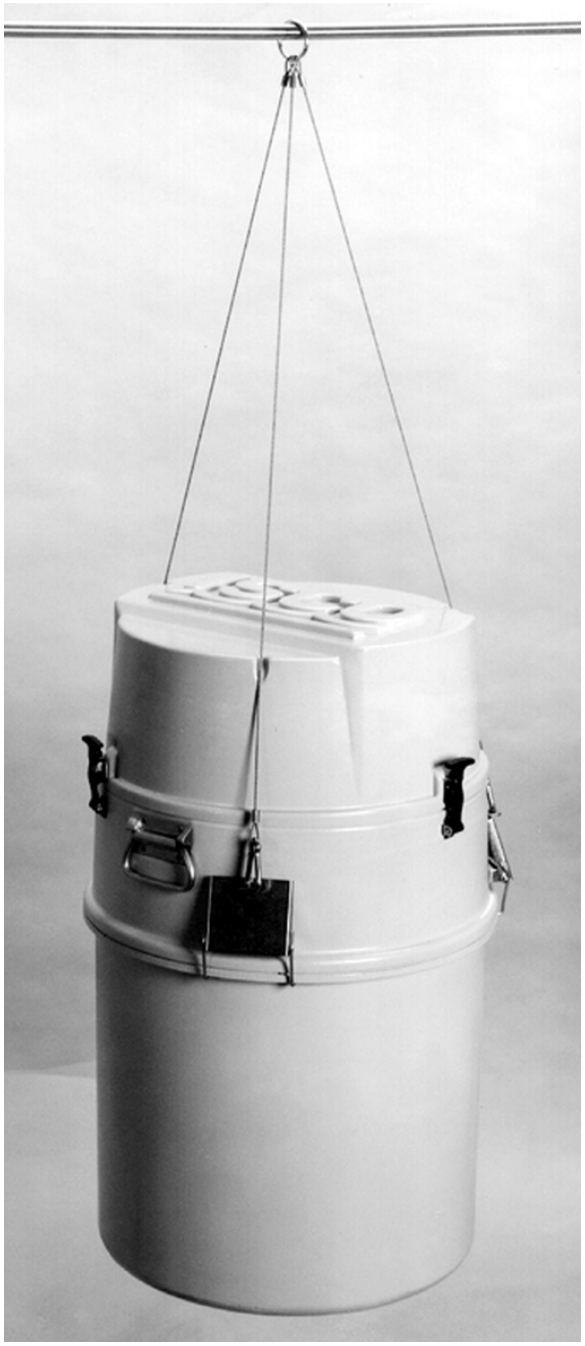


Figure 2-11 Optional Suspension Harness

2.10.2 Exchanging Base Sections

If the entire sampler is not to be returned to the lab, the full base section can be exchanged for an empty one by separating the base from the center section and installing an empty base. After the full base has been removed, place the cap on the bottle. You can also simply exchange an empty sample bottle for the full one.

Using the base section as a carrying case is convenient and prevents undue warming of cooled samples. It is good practice to attach an adhesive label detailing the location, time, date, etc., of sampling to avoid confusion.

When exchanging bottles or base sections, it is also good practice to consider the charge of the sampler's battery. If the sampler's battery is questionable, it should be exchanged with a freshly charged battery.

2.10.3 Restarting

After the base section with an empty bottle has been installed, the sampler may be started again by pressing the START SAMPLING key. It may be necessary to reprogram the start time, if one has been entered.

2.11 Sampler Locking

Locking packages are available for the standard and compact models to prevent tampering with the controls and sample bottle.

The samplers are secured with three stainless steel cables and a padlock. To secure the sampler, place the hook on the end of the cable through the hole on the latch, as shown in Figure 2-12. Repeat this with the other two cables, and gather the ends of the cables with the small loops at the center of the top cover. Then, feed the padlock through the loops and lock, as shown in Figure 2-13.

Figure 2-12 Threading the Cable

Figure 2-13 Locking the Compact Sampler

3710 Portable Samplers

Section 3 Programming Guidelines

3.1 Introduction

This section discusses the sampling features of the 3710 Standard and Compact Samplers in detail and covers the procedures used to program the sampler. Note that the standard and compact samplers share the same controller and programming, and this section refers to both models as the "sampler" or "3710 Sampler."

We recommend you have a sampler with you when you read this section. The most effective way to learn how to program the 3710 Sampler is to read this section, get a sampler, and experiment. A few minutes in the office or laboratory spent in actually programming the sampler and observing its operation usually proves to be a worthwhile investment of time.

If you are already familiar with the sampling capabilities of the 3710 Sampler, you may prefer to begin with Section 3.5. This section introduces the specifics of programming the sampler.

3.2 Description of Sampling Operations

This information serves to acquaint you with the 3710 Sampler's operation. It introduces you to the types of sampling performed by the sampler and the terminology used to describe those capabilities.

3.2.1 Sample Events and the Sampling Cycle

A sample event is the process of taking a sample. It includes the full sampling cycle. Although the cycle varies according to the program settings which define the sampling routine, the cycle described here follows the typical sequence. This information is presented here to provide you with a frame of reference for the remainder of this section.

1. A sample event is initiated when the interval since the previous sample has expired. For time based intervals, the samples are taken when the internal clock reaches the scheduled time of the sampling event. For flow-paced intervals, the interval is set to the programmed number of pulses received from a flow meter; the sample event begins when the pulses are counted down to zero.
2. The pump rotates in the reverse direction for the pre-sample purge. The pre-sample purge is an air purge of the suction line and inlet which clears the line of any accumulated debris. It also serves to purge residual liquid to avoid cross-contamination of samples.
3. The pump direction changes, pumping in the forward direction to fill the suction line up to the liquid detector.
4. After the suction line has been filled to the liquid detector and liquid has been detected, the sample volume measur-

ing portion of the sampling cycle begins. The pump continues to rotate in the forward direction until the programmed volume of liquid has been delivered to the sample bottle. (In this manual, the amount of liquid delivered to the bottle is referred to as the "sample volume.")

5. The pump direction again changes, pumping in the reverse direction for the post sample purge. Like the pre-sample purge, the post-sample purge is an air purge of the suction line. After the post-sample purge, the pump then shuts off.
6. The sample interval is reset and the cycle begins again at step 1.

3.3 Types of Samples

The 3710 Sampler is designed to collect composite samples. As noted in Section 1, the 3710 Sampler has two programming modes: basic and extended. The basic programming mode is used for conventional routines which include the types of sampling described in this section. A discussion of the types of sampling available through the extended programming mode is placed in Section 3.4. Composite sampling places individual sample volumes into a single container. Composite sample types can be characterized by sample pacing. Sample pacing refers to the interval between samples.

There are two types of sample pacing: time-pacing and flow-pacing. In time-paced sampling, the interval between samples is a time interval. In flow-paced sampling, the interval between samples is a certain volume of liquid which has passed a measuring point in a flow stream. Flow-paced sampling requires a flow meter. (The 3710 Sampler can be interfaced with Isco Flow meters and certain non-Isco Flow meters.) The flow meter measures the flow quantity and sends a pulse for every predetermined flow quantity to the sampler. The sampler totalizes the number of pulses received from the flow meter and collects a sample when the total reaches a programmed number.

3.4 Sampling Available Through the Extended Programming Mode

The extended programming mode expands the variations of sample pacing. The extended features listed below are used in more complex sampling routines. Note, however, that the sampling capabilities described previously in Section 3.3 are available in both the basic and the extended programming modes.

3.4.1 Nonuniform Time Intervals

The 3710 Sampler, through the extended programming mode, can pace samples at nonuniform time intervals. With nonuniform time intervals, samples are taken at irregular intervals, rather than at equal intervals.

Nonuniform time intervals are typically used in runoff studies, often in conjunction with an Isco 1640 Liquid Level Actuator. Nonuniform time intervals permit a number of samples to be collected at short intervals after a rainfall or other event occurs and remaining samples to be collected at widening intervals. For example, when the sampler is used with the actuator in a runoff study, the actuator turns the sampler on when the liquid level of

the flow stream rises to contact the actuator's probe. With nonuniform time intervals, the sampler can collect samples frequently when the flow rate is highest and less frequently as the flow rate decreases.

Nonuniform times can also be used to simulate flow-paced sampling. When the flow rate varies predictably, using nonuniform time intervals allows you to take samples at equal flow volumes. As the flow rate increases, you can take samples at equal flow volumes by *decreas*ing the time interval. As the flow rate decreases, you can *increase* the time interval.

When you use nonuniform times, the time interval between each sample event is individually programmable. You can enter nonuniform times in two ways: in minutes or in clock times. The first method, minutes, allows you to enter the number of sample events spaced at intervals defined in minutes: 12 samples at 5 minute intervals, 6 samples at 10 minute intervals, 4 samples at 15 minute intervals, and so on. You can also enter a specific clock time and date for each sample event: sample event 1 at 6:00 on April 20, sample event 2 at 6:30 on April 20, sample event 3 at 7:15 on April 20. You can specify up to 999 sample events spaced in nonuniform minutes, or up to 99 events specified as clock times. (If a routine requires a large number of nonuniform times, you can save the routine with the program storage feature so that you do not have to re-enter the nonuniform times again.)

3.4.2 Stops and Resumes

The Sampling Stops and Resumes feature, available in the extended programming mode, allows you to create an intermittent sampling schedule. You can program the sampler to stop the routine at a specific time. The routine can then be resumed later. Up to 12 stop times and 12 resume times can be entered. Stops and resumes can be used with time-paced and flow-paced routines and with routines programmed for nonuniform time intervals.

3.5 Programming Introduction

The sampler's programming process is self-prompting. Prompts displayed on the LCD step you through the programming sequence in a logical order, indicating the needed value or option. For example, the sampler will prompt you to enter settings for the interval between samples (select either time-paced or flow-paced intervals); sample volume in ml; and other operating controls. These settings can be changed at any time.

The sampler will accept only appropriate values for the program settings and will reject any unacceptable values. If the unit is turned off or power is disconnected, the settings are retained in the sampler's memory by the lithium battery.

3.5.1 Operating States

There are three operating states: the standby state where the sampler is waiting for your instructions, the run state where the sampler is running a sampling routine, and the interactive state used to program the sampler. Each state serves a different purpose and is discussed separately.

3.5.2 Standby State

In the standby state, the sampler is waiting for your instructions. From standby, you can start a sampling routine, placing the sampler in the run state. You can also access the interactive state. The standby state is discussed in greater detail on page 63.

3.5.3 Run State

In the run state, the sampling routine is being executed and the sampler is operating under program control. While the sampling routine is executed, the LCD displays a number of messages to communicate the progress of the sampler through the routine. It reports the current time for time-paced routines and the remaining time or pulse count to the next sample. These messages vary according to the sampling routine; a representative set of messages is included with the programming examples placed in Sections 3.6 and 3.7. Table 3-7 also lists run state messages.

As the routine progresses, the sampler creates a log of sampling results that records pertinent information about each sample event. The results include the time and date of each sample, the number of pump counts occurring until liquid is detected for each sample event, and any problems encountered. Results can be retrieved with the Display Status procedure, as explained in Section 3.14.3. You can retrieve the results in the middle of a routine or when the routine is done. The results remain in the sampler's memory until you start the sampler again. Refer to Section 3.15 for more information on the run state.

3.5.4 Interactive State

The interactive state allows you to program the sampler. The interactive state contains two branches: the program sequence and the configure sequence. Figure 3-1 diagrams the structure of the interactive state. The program sequence is used to define the sampling routine; it allows you to enter the interval between samples, the number of samples, the sample size, and the start time. The configure sequence provides a number of setup options. Some configure options provide equipment specifications: bottle sizes, suction line diameters and lengths, and so on. For example, the 3710 Standard Sampler can be used with different sized bottles: 2.5 gallon or 4 gallon. You must enter the correct bottle size so that the sampler can calculate the range of sample volumes for a given number of samples. This information is used to prevent overfilling. Other options allow you to set the sampler's real time clock, calibrate the sampler, enable the password program protection, or enable the master/slave operations.

The configure sequence also allows you to select either of the programming modes: basic or extended. The basic programming mode is used for conventional sampling routines. Using the basic programming mode, you can take samples at uniform time intervals or at flow pulse intervals. You can control the start time of the routine by entering a specific time and date or with the adjustable start time delay.

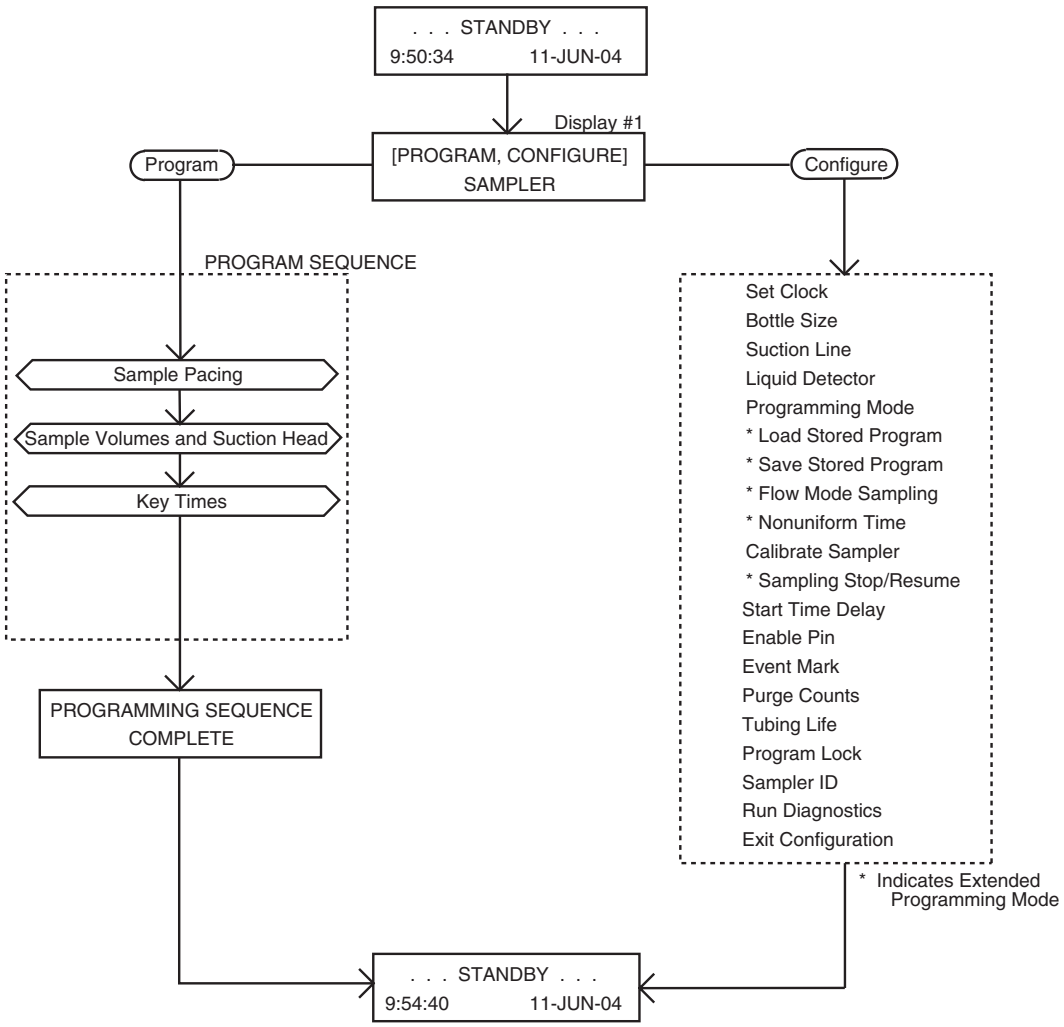


Figure 3-1 Interatctive State Structure

The extended programming mode increases the number of available features; these features make more complex sampling routines possible. For example, you can use nonuniform time intervals, and create an intermittent sampling schedule with the Stops and Resumes feature. While all basic programming features are available in the extending programming mode, the less frequently used features have been separated into the extended mode to simplify the programming process.

Although the basic and extended program sequences vary in detail, both can be divided into three sections: Sample Pacing, Sample Volume, and Key Times. These sections are noted in the Program Sequence section of the diagram shown in Figure 3-1.

The program sequence and the configure sequence are interdependent. The selections you make in the configure sequence determine what settings will be available to you in the program sequence. When you select the extended programming mode, the program sequence is modified to accommodate the extended features by adding one or more input displays.

The extended programming mode not only extends the number of features available in the program sequence, it extends the number of configure options. When you select extended programming, for example, you can enable the Sampling Stop and Resumes and/or Nonuniform Times features so they can be used in the extended program sequence. When you select the basic programming mode, these configure options are not available to you. As in the programming sequence, less frequently used options have been separated to simplify the configuration process.

Most configure options are available to both programming modes. The configure sequence options are summarized in Table 3-1. Each option is marked as available in both modes or available only in the extended mode. A detailed discussion of each configuration option is found in Sections 3.9.1 through 3.9.20.

It is usually not necessary to change the configure option settings unless the sampling application changes significantly. The sampler is *always* programmed and configured: program and configure settings are maintained by the sampler's internal battery. In fact, the sampler is shipped with factory program and configure settings. It is configured for the basic program mode and for the bottle and suction line ordered with the sampler. For more information on factory settings, refer to Section 3.9.20.

3.6 Programming Procedure

The procedure used to program the sampler follows the steps listed below. Note: Because the configuration settings determine portions of the program sequence and affect the accuracy of the sample, check the configuration settings before programming.

1. Determine the equipment you will be using with the sampler. You will need to know the capacity of the bottle and the inside diameter, type (vinyl or TEFLON), and length of the suction line. You will need this information when you verify and revise the configuration settings in step 2.
2. Check the configuration settings. From standby, access the interactive state. Select the configure sequence. Check the configuration settings, revising any settings as needed; select basic or extended programming mode. Return to the standby state.
   Example *Checking the Configure Option Settings*, on page 3-18, shows you how to check and revise the configuration settings in the configure sequence. (We recommend you review *Keypad Description* and *Displays* before you work through the programming examples. These sections discuss the functions of the individual keys and how to use the keys when programming the sampler.)

Table 3-1 Configure Option Functions

Configure Option	Availability		Function
	Basic	Extended	
Set Clock	✔	✔	Sets the sampler's real time clock.
Bottle Size	✔	✔	Sets the sampler for portable or refrigerated configuration. Sets the size of the composite bottle.
Suction Line	✔	✔	Sets the type of line (vinyl or TEFLON), line diameter (1/4- or 3/8-inch), and line length (3 to 99 ft).
Liquid Detector	✔	✔	Enables/disables liquid detector, sets the number of rinse cycles (0 to 3), enables/disables the suction head entry, and sets the number of sampling retries (0 to 3).
Programming Mode	✔	✔	Sets the programming mode: basic or extended.
Load Stored Program		✔	Loads one of up to three previously saved sampling programs.
Save Current Program		✔	Saves current sampling program.
Flow Mode Sampling		✔	Directs sampler to take a sample at the beginning of a flow-paced program.
Nonuniform Time		✔	Directs sampler to accept nonuniform intervals as specific clock times or in minutes.
Calibrate Sampler	✔	✔	Enables/disables the calibration sequence.
Sampling Stop/Resume		✔	Enables/disables Sampling Stops and Resumes feature.
Start Time Delay	✔	✔	Sets the start time delay (from 0 to 9999 minutes). If no specific start time is entered in the program sequence, the program will use the entered start time delay. The delay is the amount of time which will elapse after the START SAMPLING key is pressed or after the sampler is enabled.
Enable Pin	✔	✔	Enables/disables the master/slave sampling. Directs the sampler to take a sample when disabled and/or enabled by an Isco Flow Meter or Liquid Level Actuator. Allows you to restart the sampling interval when the sampler is enabled.
Event Mark	✔	✔	Allows you to select one of four types of event marks.
Purge Counts	✔	✔	Adjusts the number of pre-sample and post-sample purge counts.
Tubing Life	✔	✔	Displays the pump tubing life information. Resets the tubing life count.
Program Lock	✔	✔	Enables/disables the password protection for input displays.
Sampler ID	✔	✔	Allows you to enter a 10 character ID number for the sampler.
Run Diagnostics	✔	✔	Tests the RAM, ROM, and pump. Allows for re-initialization of certain program and configure settings.

3. Program the sampler. Again, from standby, access the interactive state. Select the program sequence. Enter the program settings for your routine. The sampler will prompt you through the programming process. When the process is completed, the sampler will automatically return to standby.
   A more detailed discussion of the programming procedure is placed in Section 3.7. Examples *Time-Paced Sampling*, on page 3-20 through *Calibration*, on page 3-24 demonstrate several types of sampling programs in the basic mode. Extended mode sampling programs can be found in Examples *Extended Time-Paced Sampling Using Stops and Resumes*, on page 3-53 through *Reviewing the Sampling Results*, on page 3-59.
4. Install the sampler, if you have not already done so. (The sampler can be programmed on site or in the office before installation.) If desired, connect the sampler to a flow meter, another sampler for master/slave operations, or other interfacing equipment. Start the sampler.
5. As the routine is executed, the displays will report the sampler's progress. The programming examples in this manual conclude with the run state displays you should see for each sampling routine. When the routine is done, the sampler will return to standby.
6. Retrieve the filled sample bottle. If desired, use the *Display Status* procedure, discussed in Section 3.14.3, to examine the sampling results.
7. If you need to reprogram the sampler, follow this procedure from the beginning. If the sampler's current program is correct, start the sampling routine again.

3.6.1 Following Display Cues

Configuring and programming the sampler is as simple as responding to displays on the LCD with the keypad. The sampler will prompt you through many of the entries by presenting a question or a choice on the display. You must respond with the keypad. The LCD and the keypad are located on the 3710 Sampler control panel, shown in Figure 3-2.

A summary of each key's function is placed in Section 3.6.2. For a discussion of the displays presented on the LCD and the way you can use the keypad to interact with the sampler, refer to Section 3.6.6.

3.6.2 Keypad Description

Keys are grouped together on the control panel to assist you in identifying related functions. Control keys are used to manually control the sampler; numeric keys are used to enter program values; programming keys are used to monitor the sampler's status and direct programming activities. In this manual, individual keys are indicated in SMALL CAPITAL LETTERS.

The individual key switches that make up the keypad provide tactile and audible feedback to assure you that the key switch has been successfully actuated. When a key switch is pressed, you can feel the deflection of the spring member in the switch; an

audio indicator inside the sampler will beep once. The sampler has a 10-keystroke buffer which, in some cases, allows you to "type ahead" of the display.

3.6.3 Control Keys

Control keys allow you to turn the sampler on or off, start or resume the currently entered program, and control the sampler manually. The functions of the control keys are listed below.

On/Off – Pressing the ON/OFF key when the sampler is off will turn the sampler on, reactivate the display, and place the sampler in the standby state. Pressing the ON/OFF key (when the sampler is on) will halt all sampling activity and clear the display.

Pump Forward – While in the standby state, pressing the PUMP FORWARD key will cause the pump to run continuously in the forward direction. The pump will run until the STOP key is pressed.

Pump Reverse – While in the standby state, pressing the PUMP REVERSE key will run the pump continuously in reverse. The pump will run until the STOP key is pressed.

Stop – The STOP key will stop the pump any time it is running. When the STOP key is pressed in the run state, the sampling routine will be halted, the sampler will be transferred to the standby state, and the "PROGRAM HALTED" message will be displayed. Pressing the STOP key while in the interactive state will access the display's reference number.

Start Sampling – When in the standby state, pressing the START SAMPLING key will begin the sampling program. When entering a sampler ID, the key will type a space.

Resume Sampling – When "PROGRAM HALTED" is displayed, pressing the RESUME SAMPLING key will cause the sampler to continue with the current sample program at the point at which it was halted. When entering a sampler ID, the key will type a period.

Manual Sample – Pressing the MANUAL SAMPLE key will allow you to take a manual sample. The MANUAL SAMPLE key is valid in the standby state, the run state, and when calibrating the sampler. When entering a sampler ID, the key will type a dash (-).

Figure 3-2 3710 Sampler Control Panel

3.6.4 Program Keys

The four program keys are used to enter program settings. Each key's function is listed below.

Display Status – While the sampler is in the standby or run state, pressing the DISPLAY STATUS key will allow you to view the program settings or the sampling results.

Exit Program – Pressing the EXIT PROGRAM key while in the program sequence will return the sampler to standby. Pressing the EXIT PROGRAM key while in the run state will halt the program; the message "PROGRAM HALTED" will be displayed.

Clear Entry – When entering a number, the CLEAR ENTRY key can be used to return to the original entry.

Enter/program – The ENTER/PROGRAM key, while in the standby state, will cause the sampler to enter the interactive state. While at an input display, the ENTER/PROGRAM key will accept an entered value or a blinking option and direct the sampler to proceed to the next step. Input displays are discussed in *Displays*.

3.6.5 Numeric Keys

The numeric keys consist of 10 digit keys, a LEFT ARROW key, and a RIGHT ARROW key. The digit keys are used to enter quantities. The arrow keys are used to move through the configure option list or program options.

Left Arrow – The LEFT ARROW key is used to select one of two or more program options displayed when the sampler is in the interactive state. When more than one numeric entry is displayed – for example, the hours and minutes of a time setting – the LEFT ARROW can be used to step back to a previously entered value. When entering a number, the LEFT ARROW can be used to erase the most recently entered digit. It is also used to step through display status information and configure option list.

Right Arrow – The RIGHT ARROW key is used to select one of two or more program options displayed in an input display. It is also used to step through display status information and configure option list.

3.6.6 Displays

There are two types of displays: displays which communicate information about the sampler's status and displays which request input. In many cases, you must respond to a display with the keypad.

Informational Displays – Informational displays communicate information about the sampler's status. For example, when the sampler completes a sampling program, a display similar to the illustration below appears. It communicates the sampler's status ("DONE"), the number of samples taken (which will vary according to the program), and the current time and date.

```
DONE . . . 48 SAMPLES
 10:32:34   14-APR-04
```

Input Displays – Input displays can be identified easily because they contain a blinking word or number. The blinking word or number serves as a prompt for input and is said to be "selected." When the input displays shown below first appear, the word "PROGRAM" and the sample volume entry "250" will be blinking. Blinking words or numbers are represented in illustrations of displays with *italic* characters.

```
[PROGRAM, CONFIGURE]
       SAMPLER
```

```
  SAMPLES VOLUMES OF
250  ml EACH  (10 - 990)
```

Display Numbers – Nearly all input displays have a number assigned to them. The number is used to cross reference the input displays with an explanatory listing found in Appendix D, or in the *3710 Sampler Pocket Guide*. If you have a question about a given input display, you can easily locate the description of the display.

The display number can be accessed by pressing the STOP key when viewing the input display. To see the display number, press the STOP key, read the number from the display, then look up the corresponding number in Appendix D for information on that display. The display number for the program/configure screen above is "1."

Displays With Choices – There are two types of input displays: displays which prompt you to make a choice (between time-paced and flow-paced sampling, for example) and displays which prompt for numeric input (sample volume, for example). In displays which prompt you to make a choice, you must select one of up to four alternatives placed in brackets. The display above prompts you to select the program or the configure sequence. The choices, "PROGRAM" and "CONFIGURE," are placed in brackets.

When a display prompt first appears, the blinking word indicates the currently selected choice. If the blinking word is acceptable, press the ENTER/PROGRAM key. If the blinking word is not acceptable, select the preferred choice by pressing the LEFT ARROW or RIGHT ARROW key until the preferred choice is blinking; then press the ENTER/PROGRAM key. The sampler will store the selected choice and advance to the next step.

When the display illustrated above appears, the word "PROGRAM" will be blinking. If "PROGRAM" is acceptable, press the ENTER/PROGRAM key. If "PROGRAM" is not acceptable, press the LEFT ARROW or RIGHT ARROW key until "CONFIGURE" is blinking. Then, press the ENTER/PROGRAM key. The ENTER/PROGRAM key advances to the next step.

Numeric Input Displays – A numeric input display will prompt for input by blinking the currently stored number. (In the display illustrated above, the number "250" will blink to prompt you to enter a value.) If the blinking number is acceptable, it is not necessary to type the number again: pressing the ENTER/PROGRAM key will store the number and advance the program to the next step. To enter a new number, press the appropriate numeric keys, then press the ENTER/PROGRAM key.

The sampler will not accept a number that exceeds the allowable range of values placed in parentheses on the display. In the next illustration, no less than 10 ml and no more than 990 ml can be entered as a sample volume. If an entered number exceeds the range, the sampler will emit a series of beeps and the original number will reappear. An acceptable value must be entered to advance to the next step.

3.6.7 Editing Numbers

The left arrow key and CLEAR ENTRY key can be used to edit numeric entries if they are used *after* you press a numeric key and *before* you press the ENTER/PROGRAM key. The CLEAR ENTRY key will clear any typed number and the original number will re-appear. The left arrow will erase the most recently typed number.

Some numeric input displays prompt for more than one value. In the illustration below, the prompt asks for five number entries: hours, minutes, day, month, and year. The left arrow key and RIGHT ARROW key can be used to move back and forth between each of the five entries. Individual entries can be changed, as dis-

cussed above. Pressing the right arrow or ENTER/PROGRAM key on the *last* entry will store the values and advance to the next display.

```
 HH:MM        DD-MM-YY
12:33        21-MAR-04
```

3.6.8 Military Times

Times must be entered in military format: to set the sampler's clock to 3:30 PM, enter a time of 15:30. When the display above first appears, the first two digits, "12," will blink. To enter a new time, type in the new hour: "15." Store the hour entry and advance to minutes by pressing the ENTER/PROGRAM key.

If the month or year entry does not need to be changed, accept the entry by pressing the RIGHT ARROW or ENTER/PROGRAM key. The left arrow key can be used to return to a previous position. Pressing the RIGHT ARROW or ENTER/PROGRAM key on the *last* entry, "04," will store the value and advance to the next display.

3.6.9 Exit Program Key

The user can exit an input display by pressing the EXIT PROGRAM key. If you use the EXIT PROGRAM key, the currently stored setting will not change.

3.7 Programming Examples

The following examples demonstrate the steps used to check the configure option settings and program the sampler for several different sampling routines. The programming examples in this manual present each display in the order in which they appear on the sampler. They are designed to provide you with step-by-step procedures and are provided as models for you to use later when programming the sampler for your "real" applications. Each programming example concludes with the run state displays that appear while that routine is being executed. The run state displays can be used to monitor the sampler's progress through a routine.

There are two sets of examples. Examples for the basic programming sequence are provided in Examples *Time-Paced Sampling*, on page 3-20 through *Calibration*, on page 3-24. Because many of the features of the extended programming mode are affected by selections made in the configure sequence, examples for the extended programming sequence follow the *Configure Sequence*. This section discusses each configure option separately. We recommend you become familiar with the basic programming mode procedure and examples before using the extended programming mode. Most of the procedures used in the extended programming mode duplicate those of the basic programming mode and are not repeated in the section on extended programming procedures.

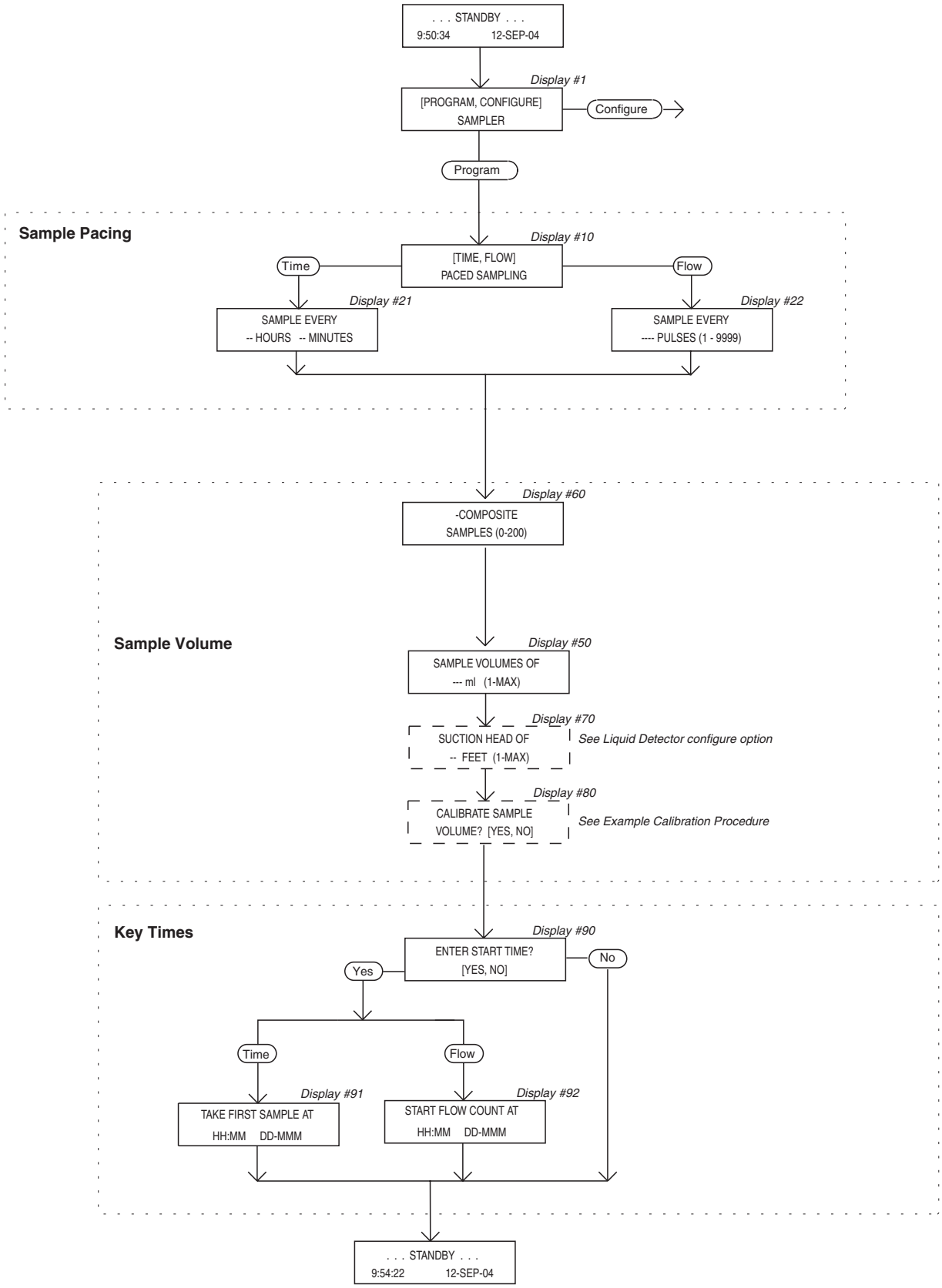


Figure 3-3 Basic Programming Mode: Program Sequence Structure

Examples for both programming modes are accompanied by flow charts. These charts diagram the program sequence structure for each mode. Figure 3-3 charts the Basic Programming Mode structure. Figure 3-5 charts the structure of the Extended Programming Mode. The charts are provided to act as a "map" to the programming process. Both charts are divided into sections – Sample Pacing, Sample Volume, and Key Times –which correspond to the steps listed in the procedure discussed below. Each chart contains the input displays used in the sequence. The input displays on each chart are labeled with their display number so they can be cross-referenced with the listing found in Appendix D.

As noted earlier, the sampler is shipped with a test program and factory configuration settings. The examples in this manual assume that all factory settings are being used, that the sampler will use a 2.5 gallon (9400 ml) container and a 10 foot length of 3/8-inch vinyl suction line. The settings with which your sampler is shipped include settings for the size of bottle ordered and for the size, type, and length of suction line. When you check the configuration settings, make sure the settings match your equipment, not the example.

Most program and configure settings can be re-initialized to factory settings, if desired. Tables 3-5 and 3-4 list the factory settings. A discussion of the re-initialize option, located in the Run Diagnostics configure option, is found in Section 3.9.20. Instructions for re-initializing the sampler are also included as part of Example *Checking the Configure Option Settings*, on page 3-18.

3.8 Basic Programming Procedure

The steps needed to program the sampler in the basic mode follow the procedure outlined below.

1. Turn the sampler on with the ON/OFF key. The sampler always "wakes up" in the standby state. The "STANDBY" message will appear. If the sampler were turned off while running a routine, the "PROGRAM HALTED" message will be displayed. Both messages indicate the sampler is in standby.
2. Press the ENTER/PROGRAM key to access the interactive state. Select "PROGRAM." Refer to Figure 3-3 for displays noted in steps 3 - 6.
   To return to a previous display when programming the sampler, press the EXIT PROGRAM key. The sampler will return to standby. Press the ENTER/PROGRAM key again to re-enter the interactive state. Continue to press the ENTER/PROGRAM key to scroll through the displays until you locate the display in question.
3. Enter the Sample Pacing settings. The sampler will prompt you to select either time- or flow-pacing. Depending on your selection, you will then be prompted to enter the time or flow pulse interval between samples.
   NOTE: If you will be using very short sample intervals, be sure the interval is longer than the duration of the sampling cycle. For truly representative sampling, the interval

in either time- or flow-paced sampling should be longer than the duration of the sampling cycle.
If the intervals are too short, no sample events will be missed, although some events will occur at improper times. The duration of the cycle can be determined by programming the sampler with the desired settings, pressing the MANUAL SAMPLE key, and simply timing the cycle.
When programming the sampler for flow pacing, you must enter the number of pulses that make up the flow interval. If the flow meter has been set to send a pulse once every 1000 gallons, you can program the sampler to collect a sample once every 1000 gallons by entering a flow pulse interval of "1." To collect a sample once every 50,000 gallons, you would enter a sample interval of 50 pulses. Appendix E provides a discussion of some of the calculations needed when determining flow pulse intervals.

4. Enter the Sample Volume settings. The Sample Volume program section will always contain prompts for the number of samples and sample volume. Depending on the selections made in the configure sequence, it may also contain prompts for the suction head and for calibrating the sampler.
   The first display of the Sample Volume section, display #60, prompts you for the number of samples you want deposited in the bottle. The acceptable range for number of samples is 0 to 999; the range is determined by the bottle size entered in the Bottle Size configure option. Enter 0 if you want the sampler to take samples indefinitely until the float shut off terminates the sampling. If you enter a number greater than zero, the sampler will take samples until it has deposited that number of samples or the float shut off terminates the sampling. The next display prompts you for the sample volume and indicates the range of acceptable volumes. The maximum range of sample volumes is dependent on the number of samples entered in the previous display; it will never exceed 9990 ml.
   When entering the sample volume, the ± 10 ml sample volume repeatability should be kept in mind. Because the entered volume is a "nominal" value, it is prudent to calculate a total sample volume that is somewhat less than the volumetric capacity of the bottle as a safety factor. This will minimize the effects of cumulative error. Refer to Section 3.9.2 for notes on cumulative error and bottle size.
   If you will be using a preservative in the sample bottle, be sure to take the volume of the preservative into account.
   The sampler can be configured, through the Liquid Detector configure option, to add the suction head setting to the program sequence. The suction head display will appear after you enter the sample volume. However, when the head is unknown or variable, the suction head setting should be omitted by disabling the suction head setting in the Liquid Detector configure option. By disabling the setting, you allow the liquid detector to determine the operat-

ing suction head each time a sample is taken.
If you want to calibrate the sample volume, the calibration option must be enabled. To enable this option, select "ENABLE" in the Calibrate Sampler configure option. (Refer to Section 3.9.11.) Enabling the option will add the calibration displays to the Sample Volume program section. The calibration displays are included in Example *Calibration*, on page 3-24.

5. Enter the Key Times settings. In the basic programming mode, you will be asked if you want to enter a start time for the routine. If you select "YES," you will be prompted to enter a specific start time and date. If you select "NO," the sampler will use the start time delay. The start time delay can be set from 0 to 9999 minutes in the Start Time Delay configure option. (See Section 3.9.13.) When you select "NO," the routine will start according to the delay setting in the Start Time Delay configure option. The time remaining between the time you press the START SAMPLING key and the next full minute will pass before beginning the delay countdown. In other words, with a start time delay of one minute, if you press the START SAMPLING key at 10:05:30, the routine will begin the one minute countdown at 10:05:00 and start the routine at 10:06:00.
When the sampler is operating under factory configuration settings and running a time-paced program, the first sample will be taken at the start time for time-paced sampling. This is true whether you enter a specific start time and date, or if you use the start time delay. For flow-paced sampling, however, the flow pulse countdown will begin at the start time and the first sample will be taken when the countdown reaches zero. Refer to the discussion on the *Flow Mode* option, in Section 3.9.10, for additional information.
6. The sampler will automatically return to standby.
7. From standby, start the routine by pressing the START SAMPLING key. This places the sampler into the run state. If you happen to start the routine after the programmed start time, the sampler will allow you to reprogram the start time.
8. Use the run state displays to monitor the sampler's progress.

Before programming the sampler – especially if you are unfamiliar with the settings used in the previous routine, or if you think the settings have been changed – verify the configure option settings. You *must* change the settings if they do not match your bottle size or the suction line used with your unit. Entries suggested in Example *Checking the Configure Option Settings*, on page 3-18, configure the sampler for the 2.5 gallon (9400 ml) container and a 10 foot length of $^{3}/_{8}$-inch vinyl suction line, enable the liquid detector, and select the basic programming mode. Procedures for re-initializing the program settings and configure options to factory settings are placed in steps 21 to 22.

Example: Checking the Configure Option Settings

1. If the sampler is not already on, press the ON/OFF key to turn it on. The standby display shown here will appear. Press the ENTER/PROGRAM key to access the interactive state. The next display you'll see is shown in Step 2.

```
. . . STANDBY . . .
10:34:50   19-JUN-04
```

2. Access the configure sequence by selecting "CONFIGURE." Select "CONFIGURE" by pressing the RIGHT ARROW key once. When "CONFIGURE" blinks, accept the selection by pressing the ENTER/PROGRAM key.

```
[PROGRAM, CONFIGURE]
        SAMPLER
```

3. The first option displayed is the Set Clock configure option. If the time displayed on the LCD in the standby message is not correct, reset the time with the Set Clock configure option. Press the ENTER/PROGRAM key to access the Set Clock input display.

```
SELECT  OPTION: (← →)
       SET CLOCK
```

4. Use this display to reset the time. Five entries are required. The LEFT ARROW and RIGHT ARROW keys can be used to move back and forth between each of the five entries. Use the arrow keys until the entry you want to change blinks. Type in the new time or date; press the ENTER/PROGRAM key to accept it. Press the RIGHT ARROW or ENTER/PROGRAM key on the *last* entry to store the values and advance to the next display.

```
   HH:MM   DD-MM-YY
10:35:20     19-06-04
```

5. To verify the Bottle Size settings, press the ENTER/PROGRAM key. The display shown in Step *6* will appear.

```
SELECT OPTION: (← →)
     BOTTLE SIZE
```

6. Select "PORTABLE" or "REFRIG" depending upon which model you have. Enter PORTABLE for either the 3710 Standard or Compact.

```
(PORTABLE, REFRIG
       SAMPLER
```

7. Enter the bottle size here. Enter "9400" for the 2.5 gallon bottles, "15000" for the 4 gallon bottle. Press the ENTER/PROGRAM key.
   If you enter a number that exceeds the maximum standard bottle size (15000), the message "WARNING: STANDARD BTL VOLUME EXCEEDED!," will display for a short time. The sampler will then prompt you to confirm the volume entered. This prompt is displayed in Step 9.

```
   BOTTLE VOLUME IS
        9400 ml
```

8. Select "YES" if you want to use the nonstandard bottle volume. Select "NO" if you want to revise the entry. The display shown in step 8 will reappear; use it to enter the revised bottle volume. Press the ENTER/PROGRAM key to accept the entry and advance to step 10.

```
15001 ml!  . .. ARE YOU
  SURE?   (YES, NO)
```

9. Press the ENTER/PROGRAM key at this display to access the Suction-Line input displays shown in steps 11 to 13.

```
SELECT OPTION: (← →)
     SUCTION LINE
```

10. Select "1/4" if you are using 1/4-inch suction line, "3/8" if you are using 3/8-inch suction line. Press the ENTER/PROGRAM key to accept the selection. If you select "1/4," you will not see the display shown in step *12*; instead you will be prompted for the suction-line length, as shown in step *13.* (You do not need to specify vinyl line type because only 1/4-inch suction line is available.)

Example: Checking the Configure Option Settings (Continued)

```
SUCTION LINE ID IS
< 1/4, 3/8> INCH
```

11. This display appears when you have selected "3/8" in step *11*. Select "VINYL" if you are using vinyl suction line, "TEFLON" if you are using TEFLON suction line. Press the ENTER/PROGRAM key to accept the selection.

```
SUCTION LINE IS
<VINYL, TEFLON>
```

12. Enter the length of the suction line. Do not include the tube coupling or the strainer in the length. Press the ENTER/PROGRAM key to accept the entry and move to step *14*. If you change the suction line settings, the ". . . CALCULATING . . . PUMP TABLE VALUES" message will appear for a short time.

```
SUCTION LINE LENGTH
IS 10 FEET (3 - 99)
```

13. Press the ENTER/PROGRAM key at this display to access the Liquid Detector input displays shown in steps 15 to 18.

```
SELECT OPTION: (← →)
  LIQUID DETECTOR
```

14. Select "ENABLE" to turn on the Liquid Detector on, "DISABLE" to turn off the Liquid Detector. For the purposes of the following examples, select "ENABLE." Press the ENTER/PROGRAM key to accept the selection. You should normally leave the detector enabled unless you suspect it is malfunctioning. If you disable the detector, you will need to enter the suction head in the program sequence.

```
[ENABLE, DISABLE]
 LIQUID DETECTOR
```

15. This display appears when you select "ENABLE" in step *15*. For the purposes of this example, enter "0." Press the ENTER/PROGRAM key to accept the entry. Rinse cycles condition the suction line to reduce cross contamination.

```
0 RINSE  CYCLES (0-3)

```

16. This display appears when you select "ENABLE" in step *15*. For the purposes of the following examples, select "NO" to omit the setting. Press the ENTER/PROGRAM key to accept the selection.

```
ENTER HEAD MANUALLY?
     [YES, NO]
```

17. This display appears when you select "ENABLE" in step 15. For the purposes of this example, set the number of retries to "0." Press the ENTER/PROGRAM key to accept the entry. This setting determines the number of times the sampler will try to detect the presence of liquid for each sample event.

```
RETRY UP TO  0 TIMES
WHEN SAMPLING (0-3)
```

18. To verify the programming mode setting, press the ENTER/PROGRAM key.

```
SELECT OPTION: (← →)
  PROGRAMMING MODE
```

19. Select "BASIC." Press the ENTER/PROGRAM key to accept the selection.

```
[BASIC, EXTENDED]
 PROGRAMMING MODE
```

20. Scroll through the remaining options with the arrow keys. Use the techniques above to change or verify the settings. If you want to reinitialize the configure and program settings to factory settings, follow the procedures given in Steps *22 to 24.*

↓
↓

21. To access the displays used in this option, press the ENTER/PROGRAM key.

Example: Checking the Configure Option Settings (Continued)

```
SELECT OPTION: (← →)
   RUN DIAGNOSTICS
```

The sampler displays the software revision number for a short period of time.

```
   SOFTWARE REVISION
         #4.5
```

The software revision display will be replaced by the RAM and ROM test messages. A successful test is indicated by the messages "RAM PASSED TEST" and "ROM PASSED TEST."

```
  'RAM' PASSED TEST
    TESTING 'ROM'
```

After successful RAM and ROM tests, the sampler will then test the LCD by first filling the display with solid rectangles and then printing the alphabet and other characters. Each position in the display should contain a character.

```
ABCDEFGHIJKLMNOPQRST
UVWXYZ [¥]^_`abcdefgh
```

The next step tests the pump. During the test, the pump will run briefly and the display will indicate an "OFF/ON" number. The number should fall within the range of 50 to 200. A count near 100 is typical.

```
   PUMP COUNT TEST
   OFF/ON  = 105
```

22. If you want to reinitialize the settings, select "YES." The entire RAM – with the exception of the current pump-count total, bottle-size settings, suction-line settings, and sampler ID – will be reinitialized to factory settings. The sampler will automatically turn itself off as part of the reinitialization process. Select "NO" if you do not want to reinitialize the settings. Press the ENTER/PROGRAM key to accept the selection.

```
   REINITIALIZE?
     [YES, NO]
```

The steps in Example *Time-Paced Sampling* program the sampler to take 250 ml samples every 15 minutes for a six hour period of time. The sampling routine is to start at 6:00 a.m.

When entering the program settings, you must enter the number of samples required before entering the sample volume. At four samples per hour, the 6 hour period would yield 24 samples. The total sample volume collected at the end of the routine would be 6000 ml (24 samples 250 ml/sample), well within the capacity of the 9400 ml (2.5 gallon) bottle.

Example: Time-Paced Sampling

1. If the sampler is not already on, press the ON/OFF key to turn it on. The standby display shown here will appear. Press ENTER/PROGRAM to access the interactive state

```
. . . STANDBY . . .
 5:34:50  19-JUN-04
```

2. Access the program sequence by selecting "PROGRAM." Because "PROGRAM" will already be selected (blinking), press the ENTER/PROGRAM key to accept it and move to the next step.

```
[PROGRAM, CONFIGURE]
      SAMPLER
```

Example: Time-Paced Sampling (Continued)

3. To enter the interval between samples in time increments, select "TIME." If "TIME" is already blinking, press the ENTER/PROGRAM key to accept the selection. If "FLOW" is blinking, press the LEFT ARROW key once so that "TIME" blinks. Then, press the ENTER/PROGRAM key to accept "TIME."

```
[TIME, FLOW]
PACED SAMPLING
```

4. This display requires two entries: one for the hours, one for the minutes. Enter "0" to set the hours at zero. Press ENTER/PROGRAM to accept the number "0" and move to the minutes entry shown in step 5.

```
SAMPLE EVERY
0 HOURS,  1 MINUTES
```

5. Enter "15" to set the minute entry. Press ENTER/PROGRAM to accept the entry.

```
SAMPLE EVERY
0 HOURS,  15 MINUTES
```

6. Enter the number of samples to be collected: "24". Press ENTER/PROGRAM to accept the entry.

```
24 COMPOSITE
SAMPLES (0-470)
```

7. Enter the sample volume: "250." Press ENTER/PROGRAM to accept the entry.

```
SAMPLE VOLUMES OF
250 ml   (10 - 1000)
```

8. Select "YES" to enter the start time for the routine.

```
ENTER START TIME?
[YES, NO]
```

9. Enter the start time and date: 6:00 on April 19.

```
TAKE FIRST SAMPLE AT
6:00              19-APR
```

After this message is displayed briefly, the sampler will automatically return to the standby state.

```
PROGRAMMING SEQUENCE
      COMPLETE
```

10. After the sampler is properly installed, press the START SAMPLING key to run the program.

```
. . . STANDBY . . .
5:38:50    19-APR-04
```

The first line of this display indicates the number of the upcoming sample event and the total number of programmed samples. The second line indicates the scheduled time of the upcoming event followed by the current time.

```
    SAMPLE 1 OF 24
AT 6:00        5:39:43
```

When the time to the next sample event has elapsed and the sampler has initiated the sample event, the sampling cycle begins. When the pump reverses for the pre-sample purge, the second line disappears.

```
    SAMPLE 1 OF 24
```

At the end of the pre-sample purge, the pump runs forward to deliver the sample, and the second line appears on the display. This display remains through the end of the post-sample purge.

```
    SAMPLE 1 OF 24
    PUMPING 250 ml
```

At the end of the sample event, the display changes to indicate the number and time of the next event. The current time is reported in the lower right corner.

```
    SAMPLE 2 OF 24
AT 6:15        6:00:33
```

Example: Time-Paced Sampling (Continued)

The cycle is repeated for the remainder of the sampling routine.

```
SAMPLE 2 OF 24
```

```
SAMPLE 2 OF 24
PUMPING 250 ml
```

↓
↓

This display appears when the routine is completed. It reports the status of the routine ("DONE"), the total number of sample events, and the current time and date.

```
DONE . . . 24 SAMPLES
6:10:35     21-JUN-04
```

The steps in Example *Flow-Paced Sampling* program the sampler to take 24, 250 ml samples at a flow pulse interval of 10 pulses. The sampling routine is to start according to the start time delay. A discussion of the calculations needed to determine the estimated time interval of flow-paced samples, the number of flow pulses, and sample volume can be found in Appendix E.

Example: Flow-Paced Sampling

1. Press the ENTER/PROGRAM key to reenter the interactive state.

```
STANDBY . . .
10:38:50  19-APR-04
```

2. Access the program sequence by selecting "PROGRAM."

```
[PROGRAM, CONFIGURE]
SAMPLER
```

3. Select "FLOW."

```
[TIME, FLOW]
PACED SAMPLING
```

4. Enter "10" to set the pulse interval to 10 pulses. (Note: An entry of "0" will instruct the sampler to take samples until the float shut-off terminates the sampling routine.)

```
SAMPLE EVERY
10 PULSES (1 - 9999)
```

5. Enter the number of samples to be collected: "24."

```
24  COMPOSITE
SAMPLES ( 0-470)
```

6. Enter the sample volume: "250."

```
SAMPLE VOLUMES OF
250 ml   (10 - 1000)
```

7. Select "NO" to use the start time delay set in the configure sequence.

```
ENTER START TIME?
[YES, NO]
```

After this message is displayed briefly, the sampler will automatically return to the standby state.

Example: Flow-Paced Sampling (Continued)

```
PROGRAMMING SEQUENCE
      COMPLETE
```

8. After the sampler is properly installed, press the START SAMPLING key to run the program.

```
  . . . STANDBY . . .
10:40:23    19-APR-04
```

This display appears during the start time delay countdown:

```
START AT 10:42 19-APR
 10:40:35 19-APR-04
```

The first line of this display indicates the number of the upcoming sample event and the total number of programmed samples. The second line indicates the number of pulses remaining to the sample event.

```
SAMPLE      1   OF    24
AFTER         10  PULSES
```

This display indicates that one pulse has been received. The pulse countdown will continue until the next sample event.

```
SAMPLE      1   OF    24
AFTER         9  PULSES
```

↓
↓

When the flow countdown reaches zero and the sampler has initiated the sample event, the sampling cycle begins. When the pump reverses for the pre-sample purge, the second line disappears.

```
     SAMPLE 1 OF 24
```

At the end of the pre-sample purge, the pump runs forward to deliver the sample, and the second line appears on the display. This display remains through the end of the post-sample purge.

```
     SAMPLE 1 OF 24
     PUMPING 250 ml
```

At the end of the sample event, the display changes to indicate the number and time of the next event.

```
     SAMPLE 2 OF 24
AFTER         10  PULSES
```

The cycle is repeated for the remainder of the sampling routine.

```
     SAMPLE 2 OF 24
```

```
     SAMPLE 2 OF 24
     PUMPING 250 ml
```

↓
↓

This display appears when the routine is completed. It reports the status of the routine (“DONE”), the total number of sample events, and the current time and date.

```
 DONE . . . 24 SAMPLES
6:10:35        20-APR-04
```

Example *Calibration* demonstrates the method used to calibrate the sampler for a 200 ml sample volume. The Calibrate Sampler configure option must be enabled in the configure sequence before the calibration displays shown below will appear.

Even without calibrating, the 3710 Sampler will deliver accurate sample volumes. If your sample volumes vary significantly with the entered values, check the suction line first. Be sure the line slopes continuously downhill and is draining completely after each pumping cycle. Then, check the suction line entries in the configure sequence to see that they are accurate. The calibration procedure is intended to be for "fine tuning" only.

After you enter the sample volume actually delivered, as shown in step 8, all subsequent sample volumes delivered will be adjusted to correct for the difference between the expected sample volume and the actual volume entered. Clear the adjustment by changing a suction line entry in the Suction Line configure option or by re-initializing the sampler.

When calibrating the sampler, best results are obtained when the unit is installed on site. If you cannot calibrate on site, be sure the calibration head matches the actual head. If the sampling will occur at a head of 10 feet, calibrate the sample volume at a head of 10 feet. Because the sample volume can be calibrated to ± 10 ml, a graduated cylinder should be used to facilitate measurement. A graduated cylinder is available from the factory. Refer to Appendix B, at the back of this manual for details.

The calibration pump cycle will include rinse cycles and retries, if the sampler is configured to perform them (see Section 3.9.6). This ensures that the calibration procedure includes the pump cycle used while running the sampling program.

Example: Calibration

1. Press the ENTER/PROGRAM key to reenter the interactive state.

```
      STANDBY . . .
  10:38:50  19-APR-04
```

2. Access the program sequence by selecting "PROGRAM."

```
[PROGRAM, CONFIGURE]
      SAMPLER
```

3. Step through the program until the "CALIBRATE SAMPLER?" input display appears (step *4*).

```
      [TIME, FLOW]
   PACED SAMPLING
```

Other program sequence displays.

↓
↓

4. Select "YES."

```
  CALIBRATE SAMPLER?
      [YES, NO]
```

5. Before pressing the MANUAL SAMPLE key, make sure a collection container is underneath the pump tube.

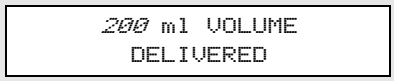
```
  PRESS MANUAL SAMPLE
  KEY WHEN READY . . .
```

6. The sampler will deliver the programmed sample volume.

```
. . . MANUAL SAMPLE . . .
     PUMPING  200 ml
```

Example: Calibration (Continued)

7. Measure the actual volume delivered and enter that value here.

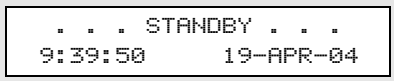


8. Repeat the procedure if desired by selecting "YES." When you are satisfied with the calibration, select "NO." Under normal conditions, you should not need to repeat the procedure.

Other program sequence displays.

↓
↓

Other program sequence displays.



3.9 Configure Sequence

The configure sequence provides a number of setup options. Some options enable sampling features, some provide reference data, and others affect run state operations.

Example *Checking the Configure Option Settings* shows the procedure used to access the configure sequence. (When you see a "SELECT OPTION: (← →)" display, you are in the configure sequence.) Each option uses at least two displays. The first display lists the option name. The second and any additional displays are input displays. To access an input display, press the ENTER/PROGRAM key while the desired option name is displayed. Once you've accessed the input display, use the keypad to enter numbers and make choices as described in Section 3.6.2 through 3.6.6.

Pressing the EXIT PROGRAM key in the configure option list will return the sampler to standby. Pressing the EXIT PROGRAM key in a configure option *input display* will return you to the list of configure options without changing the display's setting.

By pressing the LEFT ARROW or RIGHT ARROW key at the "SELECT OPTION" display in the configure sequence, you can scroll through the list of configure options without viewing each input display. If you are interested in only one or two options, you can use this method to locate the option of interest quickly.

Each option is discussed below in the order in which it appears when configuring the sampler. Individual input displays and their settings, are discussed separately within the discussion of each option. The name of the setting is placed in the left margin so you can identify each topic. Illustrations of displays are not included in each discussion; however, each discussion includes the display number, should you need to refer to display listing in Appendix D.

3.9.1 Set Clock

The Set Clock option is used to synchronize the sampler's clock with real time. Times must be entered in military time: 9:30 a.m. would be entered as 9:30, 9:30 p.m. would be entered as 21:30. When the year entry is accepted, the seconds will be reset to zero. (*Display #210*)

3.9.2 Bottle Size

The Bottles Size option is used to enter the bottle volume. The option uses two input displays:

- the first display allows you to specify a portable or refrigerated sampler
- the second sets the bottle volume.

The sampler uses the bottle volume to calculate the range of acceptable values in the sample volume input display. It also uses the volume to check for probable overfill when the sampler is programmed for flow-paced sampling.

3.9.3 Portable or Refrigerated Sampler

Because the 3700 Series portable and refrigerated samplers use the same control box, you must specify the type of unit. The 3710 Sampler will be shipped with this setting as "PORTABLE." This setting is not changed when you re-initialize the settings. You should not specify "REFRIGERATED" unless you move the control box to a refrigerated sampler. (*Display #220*)

3.9.4 Bottle Volume

The following chart lists Teledyne Isco's standard bottle sizes for composite samplers. When using Teledyne Isco's bottles, enter the bottle volume setting listed in the third column of the table. The recommended bottle sizes have been adjusted downward. Using the lower, adjusted volume helps prevent overfilling. If you are using a non-standard bottle, enter a bottle volume smaller than the actual bottle capacity. This will help prevent overfilling. (There are approximately 3785 ml per gallon.)

Bottle Configuration	Bottle Size	Bottle Volume Setting
1 glass bottle	2.5 gal	9400
1 polyethylene bottle	2.5 gal	9400
1 polyethylene bottle	4 gal	15000

Cumulative Error – The sample accuracy is the greater of 10% of the sample volume or 20 ml and is repeatable to ± 10 ml. Since samples of 150 ml can vary by 10% or ± 15 ml, the cumulative error for 24 samples would be ± 360 ml. If the sampler consistently places 24 sample volumes of 165 ml (150 ml + a 10% variation of 15 ml) in a 3800 ml bottle, the total volume deposited would be 3960 ml, overfilling the bottle by 160 ml. Again, to avoid possible overfilling, enter a bottle volume that is less than the actual bottle capacity.

3.9.5 Suction Line

The Suction Line configure option is used to configure the sampler for the type (vinyl or TEFLON), diameter, and length of the suction line used. The volumetric delivery varies with line diameter, type, and length, so it is important that these settings be entered accurately. An incorrect setting will impair the accuracy of the sample volume. These settings are also used to determine the number of post-sample purge counts. It is important to have sufficient counts to completely clear the line.

If you change the current suction line settings, the ". . . CALCULATING . . . PUMP TABLE VALUES" message will appear for a short time. Because the volumetric delivery of the sample varies with the diameter, type, and length of the suction line; the sampler must revise the internal pump tables. The tables are used as reference for the electronic pump count for sample delivery.

There are three types of suction lines available for use with the 3710 sampler: 1/4-inch vinyl, 3/8-inch vinyl, and 3/8-inch PTFE ("Teflon"). If you specify 1/4-inch line, the sampler will prompt you for the line length immediately. If you specify 3/8-inch line, the sampler will prompt you to specify vinyl or PTFE before prompting for the line length. (*Display #'s 230 and 231*)

The sampler will accept suction line lengths of 3 to 99 feet. When measuring the line, do not include the tube coupling or the strainer in the measurement. The line should be cut to even foot lengths. (*Display #232*)

3.9.6 Liquid Detector

The Liquid Detector configure option is used to turn the liquid detector on or off, set the number of rinse cycles, add a suction head setting to the program sequence, and set the number of sampling retries should the suction line become clogged. The option uses four input displays: Enable/Disable Detector, Rinse Cycles, Enter Head Manually, and Sampling Retries.

Enable/Disable Detector – The recommended setting for the Enable/Disable Detector option is "ENABLE." The 3710 Sampler determines the delivered sample volume suction head by counting revolutions of the peristaltic pump rotor. The volume of liquid delivered by one revolution of the pump rotor is a function of the suction head; as the suction head increases, the volume delivered by one revolution of the pump rotor decreases. By enabling the detector, the sampler can accurately determine the operating suction head. It does not have to rely on a programmed suction head value, but can instead begin its volume delivery count when liquid is detected. This minimizes inaccuracies that can occur in changing head conditions, or when measurement of the suction head is difficult to determine accurately.

The disable option is provided should the detector or its associated circuitry become suspect. If the detector is disabled, the manual suction head setting (*Display #70*) is automatically added to the Sample Volume program section in the program sequence. If the detector is disabled, the sampler will use a calcu-

lated number of pump counts based on the suction head entry to deliver the correct sample volume. The sampler will operate at diminished accuracy with the detector disabled. (*Display #240*)

Rinse Cycles – The Rinse Cycle setting is available only when the detector is enabled. It is used to set the number of suction line rinses, from 0 to 3. Rinses are used to condition the suction line to reduce cross contamination. During a rinse cycle, the pump draws liquid up through the line until it is detected by the liquid detector. At that point, the pump reverses to purge the line. This cycle is repeated according to the number of rinse cycles entered. (*Display #241*)

Rinse cycles contribute to the wear on pump tubing; therefore, if you use rinse cycles, it may be necessary to replace the tubing more frequently. The Tubing Life configure option (see Section 3.9.17) allows you to monitor pump tubing wear.

Enter Head Manually – Entering the head manually is available as an option when the detector is enabled and allows you to add the suction head entry (*Display #70*) to the program sequence. When the detector is disabled, the Suction Head entry is automatically added to the program sequence. By disabling the suction head setting, you allow the liquid detector to determine the operating suction head each time a sample is taken. Using the Suction Head entry in conjunction with the liquid detector, *when the head is stable and known accurately*, further increases accuracy of the delivered volume. When the head is variable or unknown, you should select "NO" because an incorrect head setting diminishes the delivered volume accuracy. (*Display #242*)

Sampling Retries – The Sampling Retries option is available as an option when the detector is enabled. It sets the number of times, from 0 to 3, the sampler will try to detect liquid in the line before skipping the sample. This option can be used when sampling liquid with a high concentration of solids which tend to clog the suction line or the strainer. The sampler will also retry the rinse cycle when you are using the Sampling Retry option. (*Display #243*)

Table 3-3 Sampling Capabilities Through the Program Sequence

Pacing	Mode	Feature
Time-Pacing: Uniform Time Intervals	Basic & Extended	Samples taken at regular time intervals from 1 minute to 99 hours, 59 minutes.
Time-Pacing: Nonuniform Clock Time Intervals	Extended	Samples taken at irregular time intervals by specifying the time and date of each sample. You can enter dates as far as one month in advance of the current date.
Time-Pacing: Nonuniform Intervals in Minutes	Extended	Samples taken at irregular time intervals by specifying the amount of time in minutes between each sample. You can enter intervals from 1 to 999 minutes.
Flow-Pacing	Basic & Extended	Samples taken at regular flow intervals. The sampler will totalize flow intervals of 1 to 9,999 pulses.

Table 3-3 Sampling Capabilities Through the Program Sequence (Continued)

Volumes and Accuracy		
Number of Samples	Basic & Extended	Number of samples needed to complete the routine. A specific number of samples (up to 999) can be entered or the sampler can be programmed to terminate the routine with the float shut-off.
Sample Volume	Basic & Extended	You can enter volumes from 10 to 9,990 ml.
Suction Head	Basic & Extended	You can enter suction heads from 1 to 20 feet.
Calibration	Basic & Extended	You can calibrate sample volumes if desired.
Key Times		
Start Times	Basic & Extended	You can enter specific start times for both time-paced and flow-paced routines. If you do not enter a start time, Start Time Delay is used.
Stop/Resume Times	Extended	You can perform intermittent sampling by defining sampling stop and resume times. You can enter as many as 12 stop and 12 resume times.
Time-Pacing	Extended	Samples taken at regular time intervals from 1 minute to 99 hours, 59 minutes.

3.9.7 Programming Mode

The Programming Mode option allows you to specify either the basic or extended programming mode. The basic programming mode is used for conventional routines; the extended programming mode can be used for either conventional or more complex routines. (*Display #250*)

Table 3-3 summarizes the sampling features according to the programming mode in the program sequence. Table 3-1 summarizes the features available in the configure sequence.

3.9.8 Load Stored Program

The Load Stored Program option allows you to load one of up to three sampling programs which have been previously saved with the *Save Current Program* configure option, discussed in Section 3.9.9. After loading a program, the sampler will adjust the time settings to current times and dates. Check the settings before starting the program to be sure they are appropriate for your application. (*Display #255*).

The sampler is shipped from the factory with four programs: the current program and three stored programs, numbered from 1 to 3. All four programs contain the factory default program settings. Unless you have previously saved a program under one of the program numbers, loading a program will replace the current program with the factory default settings. When you reinitialize the sampler, all four programs return to the default program settings.

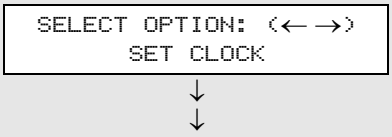
The following example shows you how to load a stored program.

Example: Load Stored Program

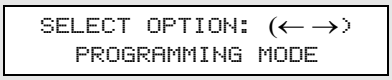
1. Press ENTER/PROGRAM to access the interactive state.

2. Access the configure sequence by selecting "CONFIGURE."

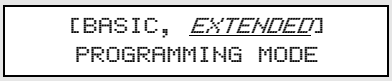
3. Press the LEFT ARROW or RIGHT ARROW key to scroll through the configure options. The first option displayed is the Set Clock configure option.



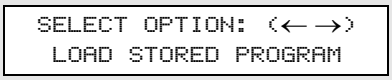
4. You can load a stored programmed only when the sampler is configured for the extended programming mode. To verify the programming mode setting, press the ENTER/PROGRAM key.



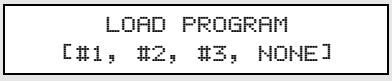
5. Select "EXTENDED." Press the enter/program key to accept the selection.



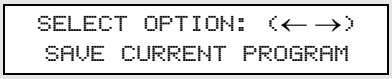
6. Press ENTER/PROGRAM to access the Load Stored Program configure option.



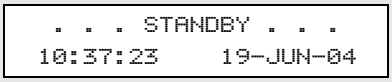
7. Select the number of the program you want to load. Select "NONE" when you do not want to load a program.



8. When the sampler has loaded the program, it will display the next configure option. When you are done configuring the sampler, press EXIT/PROGRAM to return to Standby.



9. After you properly install the sampler, press the START SAMPLING key to run the program.



3.9.9 Save Current Program

The Save Current Program option allows you to assign up to three sampling routines a number and store them. This option eliminates the need to reprogram the sampler for recurrent routines. Only the program settings are saved; if different routines require different configurations, the sampler must be reconfigured for each routine. For example, if the sampler is used at two sites, each requiring a specific sampling routine and different suction line lengths; the sampling routines can be stored for each site, but the suction line length settings must be reentered each time the line changes. (*Display #260*)

The sampler is shipped from the factory with four programs: the current program and three stored programs, numbered from 1 to 3. All four programs contain the factory default program settings. Saving a program will replace the default program with the current settings. Reinitializing the sampler will restore the default program settings. The default program settings are listed in Table 3-5.

> ☑ ***Note***
>
> Saving a program will overwrite a program saved earlier under the same number. Settings for the current program can be viewed with the Display Status procedure.

The Following example shows you how to save a program.

Example: Save Current Program

1. Press ENTER/PROGRAM to access the interactive state.

```
. . . STANDBY . . .
10:34:50  19-JUN-04
```

2. Access the configure sequence by selecting "CONFIGURE."

```
[PROGRAM, CONFIGURE]
       SAMPLER
```

3. Press the LEFT ARROW or RIGHT ARROW key to scroll through the configure options. The first option displayed is the Set Clock configure option.

```
SELECT OPTION: (← →)
      SET CLOCK
```

↓
↓

4. You can save the current program only when the sampler is configured for the extended programming mode. To verify the programming mode setting, press the ENTER/PROGRAM key.

```
SELECT OPTION: (← →)
  PROGRAMMING MODE
```

5. Select "EXTENDED." Press the ENTER/PROGRAM key to accept the selection.

```
[BASIC, EXTENDED]
  PROGRAMMING MODE
```

6. Press the RIGHT ARROW key to skip the Load Stored Program configure option.

```
SELECT OPTION: (← →)
 LOAD STORED PROGRAM
```

7. Press the ENTER/PROGRAM key to access the Save Current Program configure option.

```
SELECT OPTION: (← →)
 SAVE CURRENT PROGRAM
```

8. Select the number you want to use as the program "name." Select "NONE" when you do not want to save a program When the sampler has saved the program, it will display the next configure option. When you are done configuring the sampler, press EXIT/PROGRAM to return to Standby.

Example: Save Current Program (Continued)

```
SAVE PROGRAM AS
[#1, #2, #3, NONE]
```

9. When the sampler is properly installed, press the START SAMPLING key to run the program.

```
. . . STANDBY . . .
10:37:23    19-JUN-04
```

3.9.10 Flow Mode Sampling

The Flow Mode Sampling option is used to direct the sampler to take a sample at key times in a flow-paced sampling program.

Sample at Start Time – If you select "YES," the first sample will be taken at the start time entered in the program sequence. If you select "NO," the first sample is delayed until the number of flow pulses, set in the program sequence, have been counted down to zero. (*Display #270*)

Nonuniform Time – The Nonuniform Time option specifies the method in which nonuniform intervals are to be entered in the extended program sequence (*Display #'s 26 or 27*). If you select "CLOCK-TIME," you will be able to enter a specific time and date for each sample event when entering settings in the program sequence. If you select "MINUTES," you will be able to enter nonuniform intervals in minutes. (*Display #280*)

When you enter nonuniform times, you will be prompted to enter the number of nonuniform samples before you enter the nonuniform times. This display replaces the Number of Composite Samples display (*Display #60*) in the program sequence.

3.9.11 Calibrate Sampler

The Calibrate Sampler option is used to add or remove the calibration settings to the program sequence. If you select "ENABLE," the calibration displays will be added to the program sequence and you will be able to precisely calibrate the sample volumes. (*Display #290*)

3.9.12 Sampling Stop/Resume

The Sampling Stop/Resume configure option allows you to add stop and resume settings (*Display #'s 100, 101, and 102*) to the program sequence. The Stop/Resume settings appear in the key time section of the program sequence. (You can enter up to 24 times: 12 stop times and 12 resume times.) For example, the Stop/Resume option allows you to define a sampling routine which will take samples at intervals of 15 minutes between 6:00 a.m. to 8:00 a.m. and between 4:00 p.m. to 6:00 p.m. The stop and resume entries for this routine are shown in Example *Extended Time-Paced Sampling*, on page 3-48.

Enable/Disable – Select "ENABLE" to add the stops and resume settings to the program sequence. (*Display #300*)

Sample at Stop – The Sample at Stop setting is to direct the sampler to take a sample at stop times. (*Display #301*)

Sample at Resume – The Sample at Resume setting is used to direct the sampler to take a sample at resume times. (*Display #302*)

3.9.13 Start Time Delay

The Start Time Delay option is used to set the amount of time in minutes, between the time you press the START SAMPLING key and the time the sampling routine is initiated. The sampler's response varies according to specific entries: "0," "1," and entries greater than 1.

```
---- MINUTE DELAY
TO START (0 - 9999)
```

Display #310

An entry of "0" eliminates the delay to start time; the start time occurs the moment you press START SAMPLING. For example, if you press START SAMPLING at 10:32:15, the sampler will initiate a time-paced sample event at 10:32:15.

However, the sampler will start clocking time intervals at the beginning of the minute (HH:MM:**00**) of the first sample event. If a sampling routine requires 10 minute intervals and you pressed START SAMPLING at 10:32:15, the sampler would begin the time interval at 10:32:00. It would initiate the second sample event at 10:42:00. The sampler would begin the flow interval at 10:32:15 for flow-paced routines.

If you enter a start time delay of "1," the sampler will begin the routine at the beginning of the next minute. Thus, if you pressed START SAMPLING at 10:32:15, the sampler would initiate the sample event at 10:33:00. The sampler would begin time and flow intervals at 10:33:00. If you enter a start time delay of "2," the sampler would begin time or flow intervals at 10:34:00. (*Display #310*)

Note: If you enter a start time, the sampler will disregard the start time delay. The sampler will use the start time delay setting when you do not enter the start time in the program sequence. Care must be taken when using a start time delay of greater than zero when the sampler is being inhibited by another sampler, an Isco Flow Meter, or a Liquid Level Actuator. Refer to Section 3.9.14.

3.9.14 Enable Pin

The Enable Pin option allows you to program the sampler's response to a device controlling pin F of the flow meter connector: for example, an Isco Flow Meter or the Teledyne Isco 1640 Liquid Level Actuator. There are five Enable Pin setup options: Master/Slave Mode, Sample Upon Disable, Sample Upon Enable, Reset Sample Interval, and Inhibit Countdown.

Master/Slave Operation – The first input display, "MASTER SLAVE MODE?" is used to enable or disable the master/slave feature. Enabling the master/slave feature allows you to connect two samplers in a master/slave relationship. Using samplers in master/slave pairs allows you to conduct continuous sampling: one sampler can perform a sampling routine while the other

sampler awaits servicing. The samplers must be connected with the Master/Slave Interconnect cable. This cable is attached to the flow meter connector on both samplers.

While the master sampler is performing its sampling routine, it sends an inhibit signal out on pin D. The slave sampler receives the signal on pin F and remains dormant until the master sampler completes its routine. At this point, the samplers reverse roles.

When installing the master/slave pair, you must press the START SAMPLING key on both machines to place both machines in the run state. The first machine started becomes the master. After the master completes its routine, it can be serviced and started again. The master/slave cycle will halt if both samplers have finished their routines and have not been serviced and restarted. The samplers cannot reverse roles unless both are in the run state. (*Display #320*)

Sample Upon Disable – When you are using an Isco Flow Meter or Liquid Level Actuator, "SAMPLE UPON DISABLE?" allows you to direct the sampler to take a sample as soon as the sampler is disabled through pin F. A response of "YES" will cause the sampler to take a sample when the pin is disabled; a response of "NO" will prevent the sampler from taking a sample. (*Display #321*)

The sampler determines an enable or disable condition by monitoring the voltage on pin F. High voltage is interpreted as an enable signal. Low voltage or ground is interpreted as a disable signal.

Sample Upon Enable – When you are using an Isco Flow Meter or Liquid Level Actuator, "SAMPLE UPON ENABLE?" allows you to direct the sampler to take a sample as soon as the sampler is enabled through pin F. A response of "YES" will cause the sampler to take a sample when the pin is enabled. A response of "NO" will prevent the sampler from taking a sample when the pin is enabled. (*Display #322*)

Reset Sample Interval – "RESET SAMPLE INTERVAL?" is used to control the time or flow pulse countdown. If you select "YES," a full sample interval will begin when pin F is enabled. If you select "NO," the interval will not be reset when the sampler is enabled; the interval is then governed by settings entered in the "INHIBIT COUNTDOWN?" option. If you are sampling on a time-paced basis and wish to synchronize all sampling with real time, do not reset the sample interval. (*Display #323*)

Inhibit Countdown – "INHIBIT COUNTDOWN?" is only applicable when you respond "NO" to "RESET SAMPLE INTERVAL?" The Inhibit Countdown option is used to control the countdown while the sampler is disabled. Select "YES" to freeze the countdown to the next sample. The count will resume when the sampler is enabled. Select "NO" to allow the countdown to continue while the sampler is disabled. (*Display #324*)

3.9.15 Event Mark

The Event Mark option configures the sampler to send an event mark to an interfaced flow meter or other equipment. The sampler will supply a variable duration pulse of up to 700 mA at 12 V on pin E of the flow meter connector. Four types of signals can be sent:

- a pulse at the beginning of the pre-sample purge
- a pulse at the beginning of forward pumping only
- continuous during the entire pump cycle
- continuous during forward pumping only

The type of signal selected from the Event Mark configure option affects the event mark signal on pin E. In Figure 3-4A, a pulse signal is sent at the beginning of the pre-sample purge. In Figure 3-4B, a pulse signal is sent during the sample volume delivery portion of the sample event. In Figure 3-4C, a continuous signal is sent during the entire pump cycle. In Figure 3-4D, a continuous pulse is sent for the duration of the sample volume delivery.

Continuous/Pulse Signal – The Continuous/Pulse setting is used to select either continuous or pulse signals. Pulse signals are three seconds in duration; continuous signals are three seconds or longer and depend on the setting and the pump cycle. (*Display #330*)

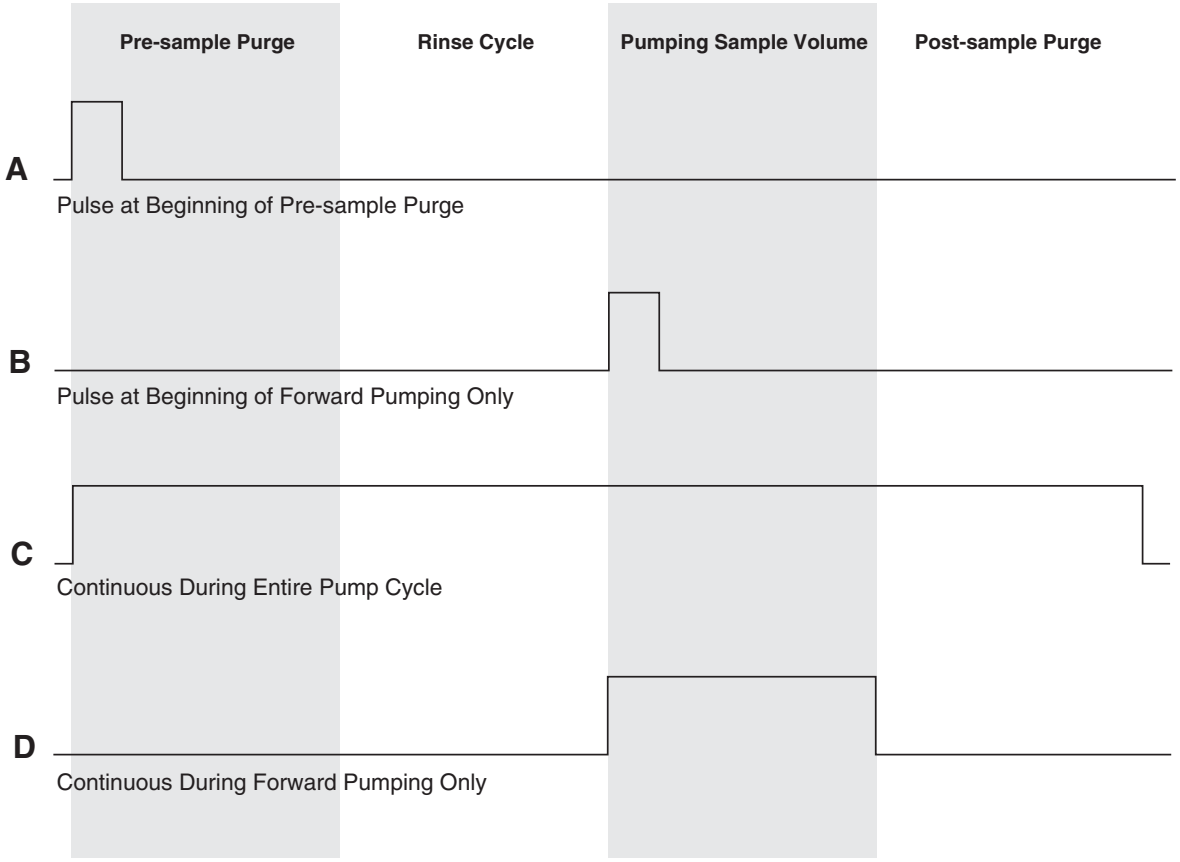


Figure 3-4 Event Mark Signal Output

Continuous Signal Timing – The Pump Cycle/Fwd Pumping settings will appear when you have selected "CONTINUOUS SIGNAL." Select "PUMP CYCLE" when you want a continuous signal transmitted during the entire pump cycle, from the beginning of the pre-sample purge to the end of the post-sample purge. Select "FWD PUMPING" when you want a continuous signal transmitted while the pump is delivering a sample volume. (*Display #331*)

Pulse Signal – The Pulse Signal setting will appear when you have selected "PULSE." Two options are available. The first option, "PURGE," is used to send a pulse at the beginning of the pre-sample purge. The second option, "FWD PUMPING," is used to send a pulse at the beginning of the sample delivery when the pump is running forward. (*Display #332*)

3.9.16 Purge Counts

The Purge Counts option is used to override the number of pump counts needed to clear the suction line in both pre-sample purge and post-sample purge cycles. The pre-sample purge count is normally set to 150 counts and will be reset to this value if the sampler is re-initialized. The post-sample purge count is derived from the suction line diameter and length settings. If your observations indicate that a greater or lesser number of pump counts in either purge is needed, you can change the count settings. Acceptable entries are between 0 and 9999 for both purges. A purge count can be obtained using the PUMP FORWARD or PUMP REVERSE keys. (*Display #'s 340 and 341*)

3.9.17 Tubing Life

The Tubing Life option is used to set the number of pump counts needed to trigger the "REPLACE PUMP TUBING" warning. The warning will be activated when the pump count reaches the entered value. You must reset the pump counter after replacing the pump tubing. If you consistently experience a tubing failure at a pump count that differs significantly from the current setting, enter that value here. The factory set value of 500,000 pump counts will deliver approximately 500 samples of 200 ml each, using a ⅜-inch × 10 ft vinyl suction line at a 5 ft suction head. (*Display #350, 351, and 352*)

3.9.18 Program Lock

The Program Lock option allows you to protect program and configure settings with a pass-number. Select "ENABLE" to turn the protection on. When the Program Lock is enabled, each protected display can be viewed, but no values can be changed without first entering the pass-number: 3710. Once the pass-number has been entered, you can change any value or setting in either the program or configure sequence. (*Display #360*)

3.9.19 Sampler ID

The Sampler ID option allows you to enter a 10 character identification number (ID) for the sampler. The ID number is used to identify sampling reports produced by the Teledyne Isco Field Printer and in files created by SAMPLINK. The sampler is shipped from the factory with 10 dashes (-) entered for the ID. (*Display #365*)

Acceptable Characters – The ID field will accept digits, dashes, spaces, and periods. You can enter spaces, dashes, and periods with three of the control keys. Enter a space with the START SAMPLING key, a dash (-) with the MANUAL SAMPLE key, and a period with the RESUME SAMPLING key.

3.9.20 Run Diagnostics

Run Diagnostics is used to perform a number of diagnostic functions. This option contains the software revision number; tests the sampler's RAM (Random Access Memory), ROM (Read Only Memory), display, and pump; and allows for re-initializing RAM. The display information is discussed below in the order of appearance.

Software Revision Number – The sampler will display the software revision number for a short period of time.

Test RAM and ROM – The software revision display is replaced by the RAM and ROM test messages. A successful test is indicated by the messages "RAM PASSED TEST" or "ROM PASSED TEST." If either the RAM or ROM fail the test, the sampler will display one of the following messages: "RAM FAILED TEST" or "ROM FAILED TEST" and beep every three seconds until you turn the sampler off. If either the RAM or ROM fail their test, the sampler should be serviced. Contact Teledyne Isco Customer Service for assistance.

LCD Test – After successful RAM and ROM tests, the sampler will then test the LCD by first filling the display with solid rectangles and then printing the alphabet and other characters. Each character position in the display should contain a character.

Pump Test – The next step tests the pump. During the test, the pump will run briefly and the display will indicate an "OFF/ON" number. The number should fall within the range of 50 to 200. If the count falls below 50 or exceeds 200, the pump should be serviced. A count near 100 is typical.

Re-initialize Controller – The final step allows you to re-initialize the sampler. If you select "NO," the sampler will return to the configure option list. If you select "YES," the sampler will reset a number of configuration and program settings, then turn the sampler off. (*Display #371*)

Tables 3-5 and 3-4 list the re-initialized settings. **Not all settings are reset.** Set Clock, Bottle Size, Suction Line, and Sampler ID configure option settings remain unchanged. This reduces the number of settings you would need to change if the sampler were accidently re-initialized. The Pump Count total is not reset to maintain an accurate count for the Tubing Life Warning.

3.9.21 Exit Configuration

This option allows you to leave the configure sequence and return to the standby state. There are no input displays. Press the ENTER/PROGRAM key to exit the configure sequence. The configuration sequence can also be exited at any time using the EXIT PROGRAM key.

3.10 Extended Programming Mode

Sampling capabilities available in the basic programming mode are available in the extended programming mode. (See Table 3-3, on page 3-28.) The extended programming mode provides several additional capabilities: Nonuniform Time pacing, Sampling Stops and Resumes, program storage, and Flow Mode Sampling controls.

The procedure used to program the sampler in the extended mode is the same as the procedure used to program the sampler in the basic programming mode. This procedure is outlined in Section 3.7. There are some exceptions, however. The extended mode modifies the sections of the program sequence to allow you to take advantage of the additional features.

The Sample Pacing program section is extended to include settings for nonuniform times. If you have enabled the Sampling Stops and Resumes configure option, the Key Times section is extended to included displays for sampling stops and resumes.

Each of these extended features is discussed briefly below. You may find it helpful to refer to Figure 3-5, which charts the program sequence in the extended mode.

3.10.1 Extended Mode Sample Pacing

In the extended programming mode, the Sample Pacing section allows you to select flow pacing, or one of two types of time-pacing: uniform or nonuniform. If you select uniform time intervals, the settings for time intervals are identical to the time intervals entered in the basic programming mode.

Nonuniform times allow you to pace the sampler at irregular intervals. Before you enter nonuniform time intervals, you must specify either minutes or clock times in the Nonuniform Times configure option. You can enter nonuniform intervals in two ways. The first method allows you to define the interval between each sample event in minutes. For example, you can program the sampler to take sample #2 after an interval of 10 minutes, sample #3 after an interval of 30 minutes, sample #4 after an interval of 60 minutes, and so on. Sample #1 would be taken at the start time. The second method allows you to enter a specific time and date for each sample event. For example, with nonuniform time pacing, samples can be collected at specific times and dates at irregular intervals: 6:00 a.m. on April 15, noon on April 15, 7:00 a.m. on April 16, and 1:00 p.m. (or 13:00 in military time) on April 16. If you have several sequences of nonuniform times, you can use the program storage feature to save the programs using each sequence.

When you enter nonuniform times, you will be prompted to enter the number of nonuniform samples — "TAKE - - SAMPLES" (*Display 25*) — before you enter the nonuniform times. This display replaces the Number of Composite Samples display (*Display #60*) in the program sequence.

3.10.2 Extended Mode Sample Volumes

The extended mode Sample Volumes section is identical to the basic Sample Volume section. It is modified only when you are using nonuniform times. The Number of Composite Samples display is removed (*Display #60*) as discussed above.

3.10.3 Extended Mode Key Times

The extended mode Key Times section has one additional set of displays which allow you to set up the sampling stop and resume times. The Stops and Resumes settings are available only when you have enabled the Sampling Stop/Resume configure option (see Section 3.9.12). You must first enter the number of stops and resumes, from 0 to 24. (Enter "0" if you want to omit the stop and resume settings without returning to the configure sequence and disabling the Stops and Resumes option.) Then enter the stop and resume clock times. The first entry will be a stop time. Refer to the Key Times section of Figure 3-5, display #'s 100, 101, and 102.

Table 3-4 Factory Program Settings

Program Setting	Display Number	Factory Setting
[TIME, FLOW] PACED SAMPLING	10	TIME
UNIFORM/ NONUNIFORM TIME INTERVALS	11	UNIFORM
SAMPLE EVERY -- HOURS -- MINUTES	21	1 HOUR, 0 MINUTES
SAMPLE EVERY ---- PULSES (1 - 9999)	22	10
TAKE --- SAMPLES (1 - MAX)	25	10
QUANTITY AT INTERVAL 1. -- AT --- MINUTES	27	1 at 60 MINUTES
SAMPLE VOLUMES OF --- ml EACH (10 - *MAX*)	50	200
--- COMPOSITE SAMPLES (0 - *MAX*)	60	10
SUCTION HEAD OF -- FEET (1 - *MAX*)	70	10
ENTER START TIME? [YES, NO]	90	NO

Table 3-5 Factory Configure Option Settings

Configure Option	Display Number	Factory Setting
Set Clock	210	Not Reset
Bottle Size	220, 223	Not Reset
Suction Line	230, 231, 232	Not Reset
Liquid Detector		
Liquid Detector	240	Enable
Rinses	241	0

Table 3-5 Factory Configure Option Settings (Continued)

Configure Option	Display Number	Factory Setting
Enter Head Manually	242	No
# Of Retries	243	0
Programming Mode	250	Basic
Load Stored Program	255	
Save Current Program	260	
Flow Mode Sampling		
Sample At Start Time	270	No
Nonuniform Time	280	Minutes
Calibrate Sampler	290	Disable
Sampling Stop/resume	300	Disable
Sample At Stop Times	301	No
Sample At Resume Times	302	No
Start Time Delay	310	2
Enable Pin		
Master/slave	320	Disable
Sample Upon Disable	321	No
Sample Upon Enable	322	No
Reset Sample Interval	323	No
Inhibit Countdown	324	No
Event Mark		
Continuous /pulse	330	Continuous Signal
Pump Cycle/fwd Only	331	Fwd Pumping Only
Purge/fwd Pumping	332	Fwd Pumping
Purge Counts		
Pre-sample Counts	340	150
Post-sample Counts	341	Based On Line Length
Tubing Life		
Reset Pump Counter	351	No
# Pump Counts	352	Not Reset
Program Lock	360	Disable
Sampler Id	365	Not Reset
Run Diagnostics		
Re-initialize?	371	No

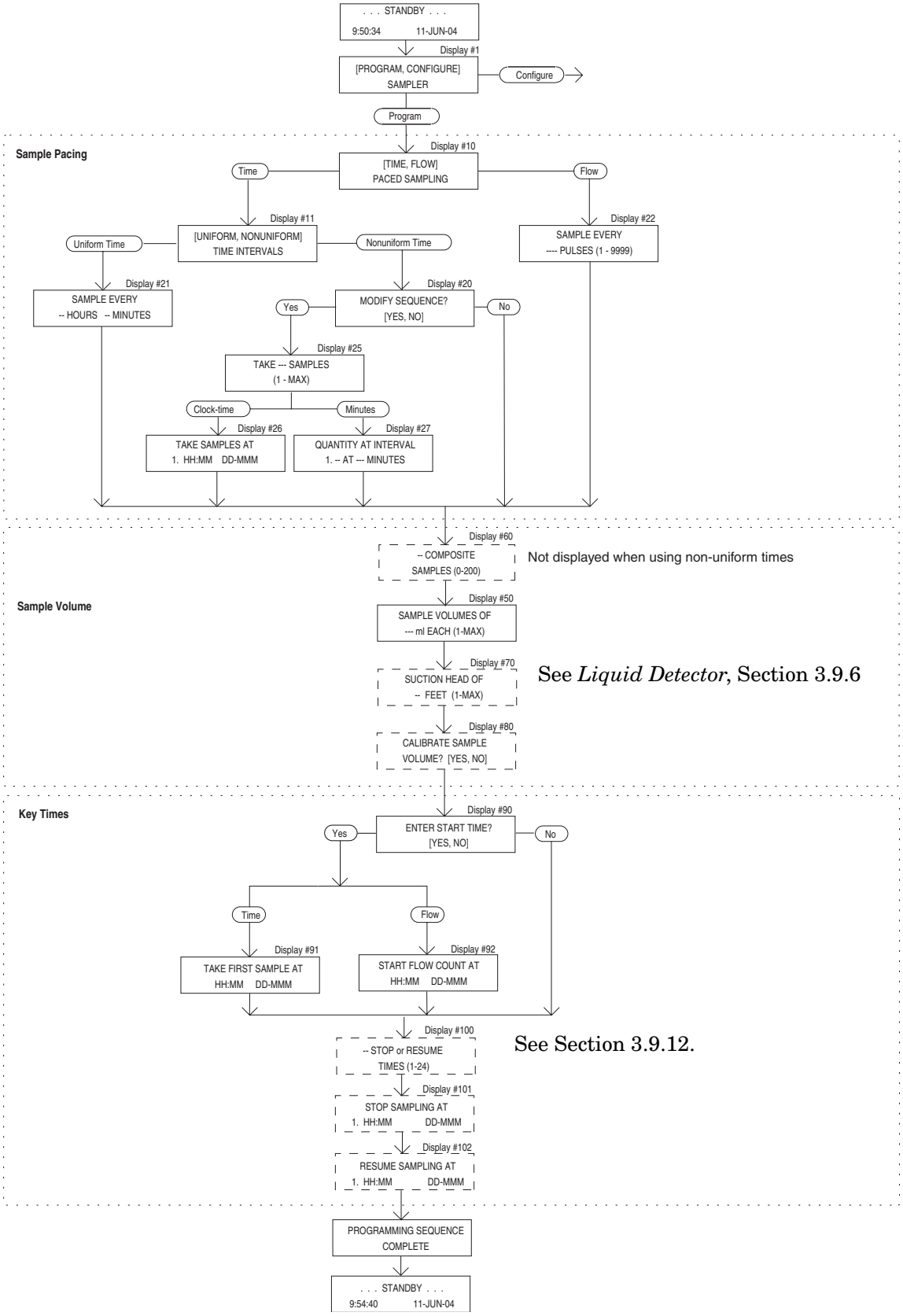


Figure 3-5 Extended Programming Mode: Program Sequence Structure

3.10.4 Sampling Stop/Resume

The Stops and Resumes settings are available only when you have enabled the Sampling Stop/Resume configure option. You must first enter the number of stops and resumes, from 0 to 24. (Enter 0 if you want to omit the stop and resume settings without returning to the configure sequence and disabling the Stops and Resumes option.) Then enter the stop and resume clock times. The first entry will be a stop time. Refer to Display numbers 100, 101, and 102.

Determining the Number of Samples with Stops and Resumes – When using stops and resumes, determining the number of samples you want deposited in the container requires a little planning. With a time-paced routine, a sample will always be taken automatically at the *start* time. No sample will be taken at the *stop* time unless you have selected "ENABLE" in the Sample at Stop Time display of the Sampling Stops and Resumes configure option, even if the stop time falls at a scheduled sample event time. No sample will be taken at the *resume* time unless you have selected "ENABLE" in the Sample at Resume display of the Sampling Stops and Resumes option.

When you are using Stops and Resumes with flow-paced routines, a sample will not be taken at the start time, unless you have configured the sampler to do so in the Flow Mode Sampling configure option. With flow-paced routines, no sample will be taken at the stop time unless you have selected "ENABLE" in the Sample at Stop Time display of the Sampling Stops and Resumes option. No sample will be taken at the resume time unless you have selected "ENABLE" in the Sample at Resume display of the Sampling Stops and Resumes option.

If the number of samples deposited is not important to you or if you are using a flow-paced routine for a flow-steam with an unpredictable flow rate, enter "0" in the Number of Composite Samples display (*Display #60*). The sampler will take samples indefinitely, governed by the scheduled stop and resume time. It will be "DONE" at the final stop time or when the float shut-off terminates the routine.

3.11 Start Times

This section discusses the sampler's start times. It begins by outlining the sequence of events preceding the start time for most sampling routines.

3.11.1 Events Preceding Sampling Routine

After you program a sampler, you must start the sampling routine by pressing the START SAMPLING key. However, depending on the program and configure option settings, the sampling routine may not start at soon as you press the key. The "Delay to Start Time" is the period between the time you press START SAMPLING and the start time for the routine. Figure 3-6 diagrams the sequence of events preceding the start time.

The start time for a routine is either the programmed start time or the time at which the delay to start time expires. The programmed start time is determined by entries made in Displays

#90, #91, and #92. The delay to start time is determined by the entry in Display #310 of the Start Time Delay configure option. These input displays are illustrated in Table 3-6, on page 3-43.

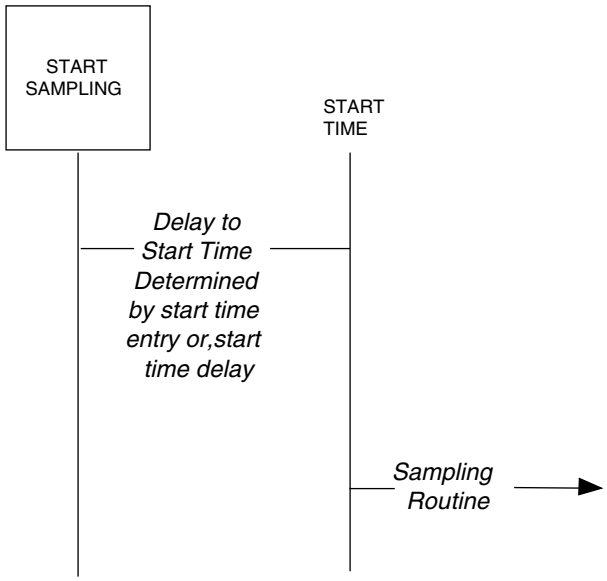


Figure 3-6 Simplified Start Time Diagram

Table 3-6 Start Time Displays

ENTER START TIME? [YES, NO]	**Display #90**
TAKE FIRST SAMPLE AT HH:MM DD-MMM	**Display #91** **(time-paced sampling)**
START FLOW COUNT AT HH:MM DD-MMM	**Display #92** **(flow-paced sampling)**
STORM ENABLED AFTER HH:MM DD-MMM	**Display #93** **(storm-paced sampling)**
Start Time Delay display (Configure Sequence)	
---- MINUTE DELAY TO START (0 - 9999)	**Display #310** **(Start Time Delay configure option)**

> **Note**
>
> Unless the sampling routine contains a programmed start time (Displays #91 or #92), the sampler will delay the start time according to the amount of time specified in the Start Time Delay configure option. A programmed start time entry always overrides any settings made in the Start Time Delay configure option.

Isco Flow Meters and Flow Loggers provide two essential functions for certain sampling applications. They send flow-pacing signals — flow pulses — to the sampler for flow-paced sampling. The second function provides disable (inhibit) or enable signals to the sampler. A sampler receiving a disable signal will suspend the sampling routine until it receives an enable signal.

The sampler will *disregard* a disable signal received from a flow meter during the delay to start time. If the sampler is disabled when the start time occurs, it will suspend the routine until it is enabled. Once enabled, the sampler will begin the time or flow intervals. The sampler will initiate a sample event when enabled for all time-paced routines. For flow-paced routines, it will initiate a sample event when the sampler is configured to take a sample upon enable in the Enable Pin configure option (Section 3.9.14).

If the sampler is enabled when the start time occurs, it will begin the routine. The sampler will initiate a sample event at the start time for all time-paced routines. It will initiate a sample event at the start time for flow-paced routines when configured for sample at start time in the Flow Mode configure option (Section 3.9.10). Refer to Figure 3-7, on page 3-46. The diagram shows the sampler's response when enabled or disabled at the start time for most basic and extended mode routines.

3.11.2 Nonuniform Times and Disable Signals

Figure 3-8, on page 3-47, diagrams the sequence of events preceding a routine programmed for nonuniform clock times. Nonuniform clock time programming allows you to enter a specific time and date for each sample event. Samplers programmed with nonuniform clock times may skip a number of samples if disabled for long periods. If the sampler is disabled and subsequently enabled, it will initiate only one event to compensate for the skipped sample events even if several sample event times have been passed.

> **Note**
>
> Nonuniform clock time programming is designed to replace flow-pacing when a flow meter is not available at the site. Before using a sampler programmed for nonuniform clock times with a flow meter, be sure flow-pacing is not a more appropriate application.

3.11.3 Manual Sample Key and Programmed Start Times

The sampler will disregard the MANUAL SAMPLE key during the delay to start time and during the disable period. The periods where the sampler disregards disable signals (Delay to Start) and the MANUAL SAMPLE key (when disabled) appear in Figures 3-7 and 3-8.

Entries made in the Start Time Delay configure option affect the start times. See Section 3.9.13.

3.12 Foreign Languages and Metric Units

The 3710 Sampler provides displays in French, Spanish, and German. Additionally, it supports entries in metric units of measure. Metric units include volumes in milliliters, suction head and suction line length in decimeters, and suction line ID in millimeters.

Samplers using French, Spanish, and German language displays support metric units for suction line and suction head measurements. Samplers operating with English displays support either English or metric units for suction line and suction head measurements. (Sample volumes are always entered in milliliters, regardless of the selected language.)

To program the sampler for foreign language displays, begin by placing the sampler in standby. Then, access the language programming sequence by pressing the STOP key five times. The standby display will be replaced by the input display illustrated below.

```
[English, German,
Spanish, French]
```

Select the preferred language from this display. If you select French, Spanish, or German, the sampler will automatically convert English units of measure to metric units and return to standby. If you select English, the input display shown below will appear. Select the units of measure from this display. After you've made the selection, the sampler will convert the units of measure as required and return to standby

```
[U.S., Metric]
    Units
```

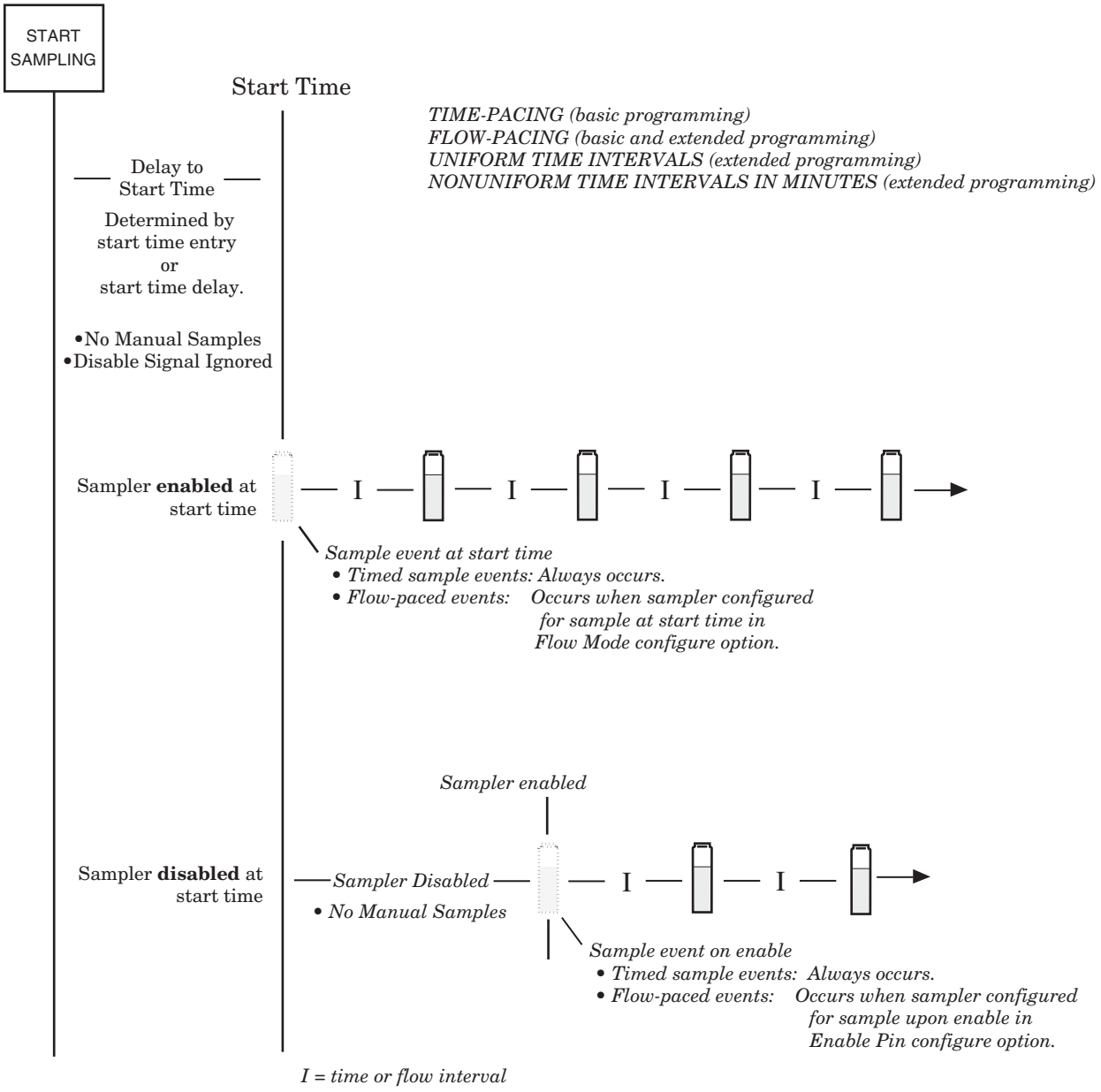

START SAMPLING
Start Time
TIME-PACING (basic programming)
FLOW-PACING (basic and extended programming)
UNIFORM TIME INTERVALS (extended programming)
NONUNIFORM TIME INTERVALS IN MINUTES (extended programming)
Delay to Start Time
Determined by start time entry or start time delay.
•No Manual Samples
•Disable Signal Ignored
Sampler enabled at start time
I
Sample event at start time
• Timed sample events: Always occurs.
• Flow-paced events: Occurs when sampler configured for sample at start time in Flow Mode configure option.
Sampler disabled at start time
Sampler enabled
Sampler Disabled
• No Manual Samples
Sample event on enable
• Timed sample events: Always occurs.
• Flow-paced events: Occurs when sampler configured for sample upon enable in Enable Pin configure option.
I = time or flow interval

Figure 3-7 Start Time Diagram

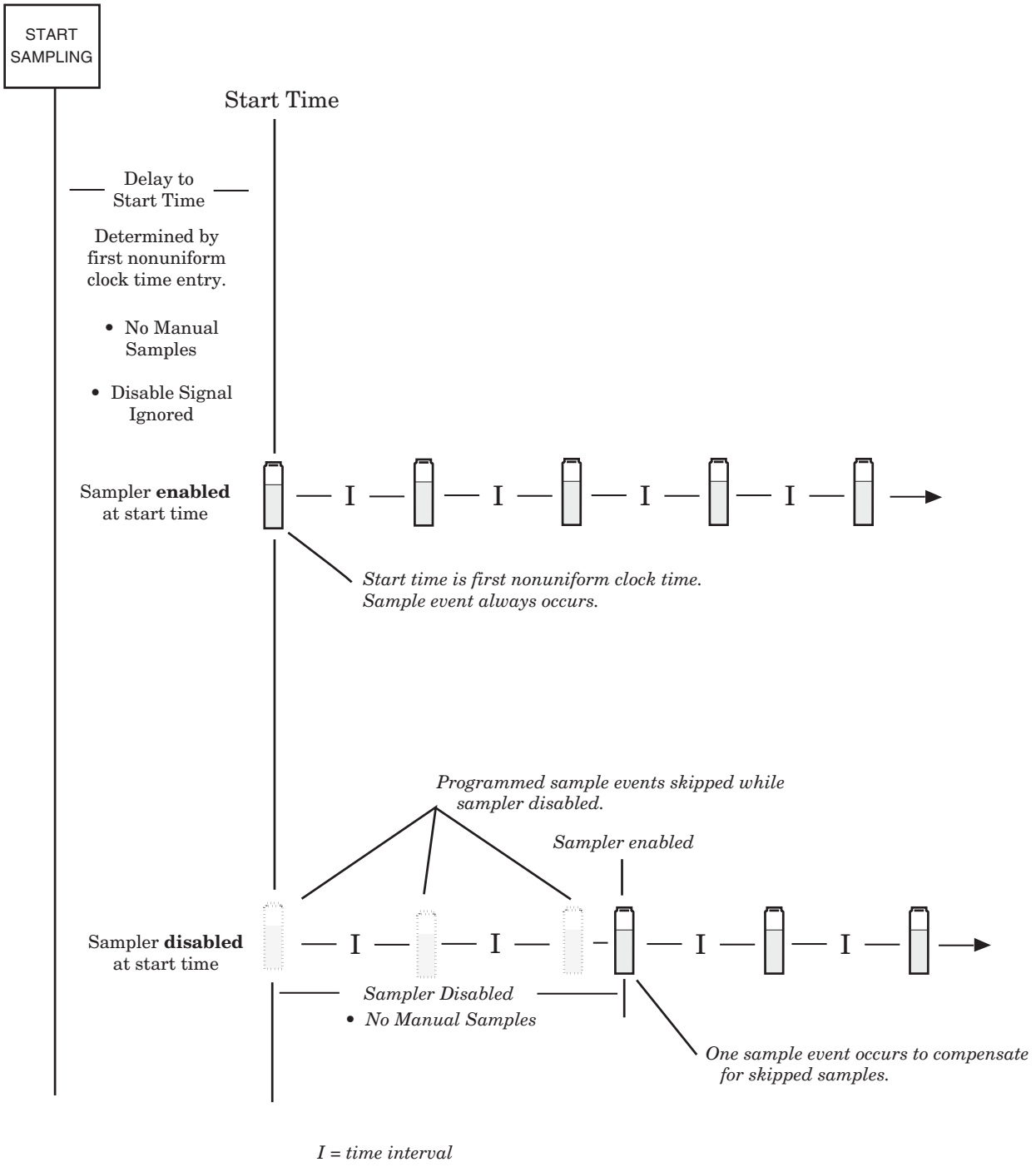

START SAMPLING
Start Time
Delay to Start Time
Determined by first nonuniform clock time entry.
• No Manual Samples
• Disable Signal Ignored
Sampler **enabled** at start time
Start time is first nonuniform clock time. Sample event always occurs.
Programmed sample events skipped while sampler disabled.
Sampler enabled
Sampler **disabled** at start time
Sampler Disabled
• *No Manual Samples*
One sample event occurs to compensate for skipped samples.
I = time interval

Figure 3-8 Start Time Diagram for Nonuniform Clock Time Routines

3.13 Programming Examples

The examples throughout this section demonstrate the steps used to program the sampler for several different sampling routines in the extended programming mode. Each programming example concludes with the run state displays that appear for that routine. The examples assume you are familiar with the functions of the keys as discussed in Sections 3.6.2 and 3.6.6.

The following example programs the sampler to take 12 time-paced 500 ml samples. Samples are to be taken at uniform time intervals of 30 minutes starting at 8:00 a.m. on the following day.

Example: Extended Time-Paced Sampling

1. Press ENTER/PROGRAM to access the interactive state.

```
. . . STANDBY . . .
10:34:50  19-APR-04
```

2. Access the program sequence by selecting "PROGRAM."

```
[PROGRAM, CONFIGURE]
      SAMPLER
```

3. Select "TIME."

```
[TIME, FLOW]
PACED SAMPLING
```

4. Select "UNIFORM."

```
[TIME, FLOW]
PACED SAMPLING
```

5. Enter "0" to set the hours at zero. Press ENTER/PROGRAM to store the number "0" and move to the minutes entry.

```
     SAMPLE EVERY
0 HOURS,  10 MINUTES
```

6. Enter "30" to set the minutes entry to 30.

```
     SAMPLE EVERY
0 HOURS,  30 MINUTES
```

7. Enter the number of samples to be collected: "12."

```
   12  COMPOSITE
SAMPLES ( 0-470)
```

8. Enter "500" to set the sample volume at 500 ml.

```
  SAMPLE VOLUMES OF
500 ml EACH  (10 - 780)
```

9. Select "YES."

```
ENTER START TIME?
    [YES, NO]
```

10. Enter the start time and date: 8:00 on April 20.

```
TAKE FIRST SAMPLE AT
   8:00   20-APR
```

After this message is displayed briefly, the sampler will automatically return to the standby state.

```
PROGRAMMING SEQUENCE
   COMPLETE . . .
```

When the sampler is properly installed, press the START SAMPLING key to run the program.

Example: Extended Time-Paced Sampling (Continued)

```
  . . . STANDBY . . .
10:37:23    19-APR-04
```

This display appears as the sampler counts down the time remaining to the start time. The first line reports the number of the upcoming sample event and the total number of sample events for the routine. The second line reports the start time at the left and the current time on the right.

```
     SAMPLE 1 OF 12
AT 8:00      10:38:07
```

When the start time occurs, the sampler will take the first sample. The sample event cycle begins with a pre-sample purge. During the purge, the display indicates the sample event number and the number of sample events for the routine.

```
     SAMPLE 1 OF 12

```

As soon as the pump runs forward to deliver the sample volume, the message on the second line appears and remains through the post-sample purge.

```
     SAMPLE 1 OF 12
     PUMPING 500 ml
```

This display appears when the post-sample purge from the previous sample event is completed. It indicates the number of the upcoming sample event. The second line displays the scheduled time for the next event on the left. The current time is displayed on the right.

```
     SAMPLE 2 OF 12
  AT 8:30     8:01:11
```

The cycle of displays is repeated until the sampling routine is done.

↓
↓

When the routine is completed, this message appears. It reports the status of the routine (“DONE”), the total number of sample events, and the current time and date.

```
 DONE . . . 12 SAMPLES
2:10:35        20-APR-04
```

The following example programs the sampler to take time-paced samples at nonuniform time intervals. This example assumes the sampler is connected to a Liquid Level Actuator which will inhibit the sampler until the liquid level rises to contact the Actuator probe.

The sampler is to take 20, 100 ml samples: the first samples are to occur at 10 minute intervals for one hour, the following samples at 20 minute intervals for one hour, and the remaining samples at 30 minute intervals. Although this example assumes that nonuniform times are being used with the Actuator, uniform time intervals or flow intervals can be used with the Actuator as well.

Example: Nonuniform Time-Paced Sampling

1. Press ENTER/PROGRAM to access the interactive state.

```
. . . STANDBY . . .
10:34:50  19-JUN-04
```

2. Access the program sequence by selecting "PROGRAM."

```
[PROGRAM, CONFIGURE]
      SAMPLER
```

3. Select "TIME."

```
[TIME, FLOW]
PACED SAMPLING
```

4. Select "NONUNIFORM."

```
[UNIFORM, NONUNIFORM]
TIME INTERVALS
```

5. Select "YES" to modify the sequence of nonuniform time entries.

```
MODIFY SEQUENCE?
    [YES, NO]
```

6. Enter the total number of samples: "20." This entry should always include the sample taken at the start time.

```
TAKE 20 SAMPLES
    (1-470)
```

7. Enter the number of samples to occur at the first interval. The sampler is to take samples at 10 minute intervals for one hour or 6 samples in the first hour. Since the first sample is taken at the start time, the remaining five samples will occur at the 10 minute intervals.

```
QUANTITY AT INTERVAL
1.  5 AT 10 MINUTES
```

8. When you have completed the first entries, the display will "roll" to move the first interval entries to the first line, and add the second line entries for the next series of samples and intervals. Enter the next entries: "3" samples at "20" minutes.

```
1.  5 AT 10 MINUTES
2.  3 AT 20 MINUTES
```

9. Enter the third set of samples and intervals, "11" samples at "30" minutes.

```
2.  3 AT 20 MINUTES
3. 11 AT 30 MINUTES
```

10. Enter "100" to set the sample volume at 100 ml.

```
  SAMPLE VOLUMES OF
100 ml EACH  (10 - 470)
```

11. Select "NO."

```
ENTER START TIME?
    [YES, NO]
```

After this message is displayed briefly, the sampler will automatically return to the standby state.

```
PROGRAMMING SEQUENCE
      COMPLETE
```

12. Press the START SAMPLING key to run the program.

```
. . . STANDBY . . .
10:37:23    19-APR-04
```

Example: Nonuniform Time-Paced Sampling (Continued)

This display appears while the actuator is inhibiting the sampler. The second line indicates the current time and date.

```
  SAMPLER INHIBITED!
10:35      20-APR-04]
```

This display appears when the sampler becomes enabled and counts down the time remaining to the start time. The first line reports the number of the upcoming sample event and the total number of sample events for the routine. The second line reports the start time at the left and the current time on the right.

```
     SAMPLE 1 OF 20
AT 11:26       11:25:47
```

13. When the start time occurs, the sampler will take the first sample. The sample event cycle begins with a pre-sample purge.

```
     SAMPLE 1 OF 20
```

As soon as the pump runs forward to deliver the sample volume, the message on the second line appears. This message remains through the post-sample purge.

```
     SAMPLE 1 OF 20
     PUMPING 100 ml
```

This display appears when the post-sample purge from the previous sample event is completed. It indicates the number of the upcoming sample event. The second line displays the scheduled time for the next event on the left; the current time is displayed on the right.

```
     SAMPLE 2 OF 20
AT 11:36:      11:26:11
```

The cycle of displays is repeated until the sampling routine is done.

```
          ↓
          ↓
```

When the routine is completed, this message appears. It reports the status of the routine (“DONE”), the total number of sample events, and the current time and date.

```
  DONE . . 20 SAMPLES
8:10:35        21-APR-04
```

Nonuniform times can be entered in either the method shown in the previous example or by specifying a clock time and date for each sample. The abbreviated example below shows the displays used to enter the clock times. (The type of display, clock time or minutes, used in the program sequence is controlled by the settings in the Nonuniform Times configure option; you must specify either clock time or minutes.)

Example: Entering Nonuniform Times as Specific Clock Times

1. Enter the time and date for the first sample event. Times and dates are entered on the second line of the display.

```
TAKE SAMPLES AT
1. 06:00 19-APR
```

2. Enter the time and date for the second sample event. The controller will guess a time at the hour succeeding the previously entered time.

```
1. 06:00 19-APR
2. 07:00 19-APR
```

3. Enter the time and date for the third sample event.

```
2. 06:30 19-APR
3. 07:00 19-APR
```

4. Continue to enter times and dates for each sample event.

↓
↓

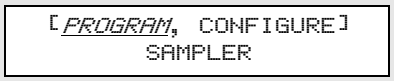
The following example programs the sampler to take time-paced 200 ml samples at uniform time intervals of 15 minutes starting at 6:00 a.m. on the following day. The sampling is to continue from 6:00 a.m. until 8:00 a.m. The sampling will resume again at 11:00 a.m. and continue until 1:30 p.m. It will pause until 4:00 p.m. and continue until 6:00 p.m.

When the sampling is stopped at 6:00 p.m., 24 to 29 samples will have been taken. However, in this particular application, the number of samples is not important, so the sampler will be instructed to take samples indefinitely. This is done by entering "0" in the Number of Samples display as demonstrated in step 7 below. Note: The Sampling Stop and Resumes configure option has settings which allow you to take a sample at the stop and resume times. See Section 3.9.12.

Example: Extended Time-Paced Sampling Using Stops and Resumes

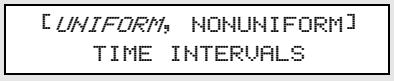
1. Press ENTER/PROGRAM to access the interactive state.

2. Access the program sequence by selecting "PROGRAM."

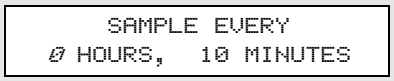


3. Select "TIME."

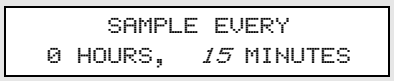
4. Select "UNIFORM."



5. Enter "0" to set the hours at zero. Press ENTER/PROGRAM to store the number "0" and move to the minutes entry.



6. Enter "15" to set the minutes entry to 15.

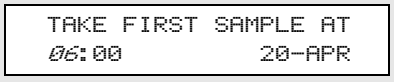


7. Enter "0" so that the sampler will take samples until the last stop time or until the shut-off float terminates the sampling routine.

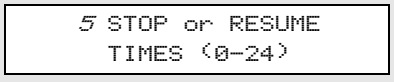
8. Enter "200" to set the sample volume at 200 ml.

9. Select "YES."

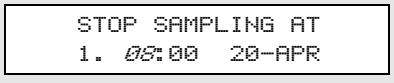
10. Enter the start time and date of the sampling program: 6:00 a.m. tomorrow.



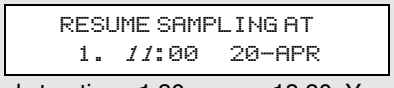
11. Enter "5." There are three stop times and two resume times.



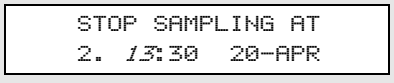
12. Enter the time and date of the first stop time: 8:00 a.m.



13. Enter the time and date the program should resume: 11:00 a.m.



14. Enter the time and date of the second stop time: 1:30 p.m. or 13:30. You must enter the times in military time.



15. Enter the time and date the program should resume: 4:00 p.m. or 16:00 in military time.

Example: Extended Time-Paced Sampling Using Stops and Resumes

```
RESUME SAMPLING AT
 2. 16:00  20-AP
```

16. Enter the final stop time: 6:00 p.m. or 18:00 in military time.

```
STOP SAMPLING AT
3. 18:00  20-APR
```

After this message is displayed briefly, the sampler will automatically return to the standby state.

```
PROGRAMMING SEQUENCE
  COMPLETE . . .
```

17. Press the START SAMPLING key to run the program.

```
. . . STANDBY . . .
10:37:23    19-APR-04
```

This display appears as the sampler counts down the time remaining to the start time. The first line reports the number of the upcoming sample event. The question marks, in the upper right, appear for routines which will take an indeterminate number of samples. The routine will terminate when the float shut-off is triggered. The second line reports the start time at the left and the current time on the right.

```
 SAMPLE 1 OF  ? ? ?
AT 6:00      10:38:07
```

When the start time arrives, the sampler will take the first sample. The sample event cycle begins with a pre-sample purge.

```
 SAMPLE 1 OF  ? ? ?
```

As soon as the pump runs forward to deliver the sample volume, the message on the second line appears. This message remains through the post-sample purge.

```
 SAMPLE 1 OF  ? ? ?
  PUMPING 500 ml
```

This display appears when the post-sample purge from the previous sample event is completed. It indicates the number of the upcoming sample event. The second line displays the scheduled time for the event on the left. The current time is displayed on the right.

```
 SAMPLE 2 OF  ? ? ?
AT 6:15     8:01:11
```

The cycle of displays is repeated until the sampling routine is done.

↓
↓

When the routine is completed, this message appears. It reports the status of the routine (“DONE”), the total number of sample events, and the current time and date.

```
DONE . . . 26 SAMPLES
18:10:35     21-APR-04
```

Example: Program Started Later Than Programmed Start Time

This display informs you of the expired start time. The sampler presents this display for a short time, then advances to the next display.

```
PAST START TIME . . .
```

This display reports the number of samples that will be skipped if you do not change the start time; it appears only if more than one sample event time has passed.

```
1  SAMPLES WILL BE
      SKIPPED
```

1. Select "YES" if you want to change the start time. Select "NO" if missed samples are acceptable.

```
CHANGE START TIME?
    [YES, NO]
```

Display 142

2. This display appears when you select "YES" in display #142 and a sample event is to occur at the start time. Enter the new start time.

```
TAKE FIRST SAMPLE AT
  12:30     19-JUN
```

Display 93

3. This display appears when you select "YES" in display #142 and no sample is to occur at the start time for a flow-paced sampling routine. Enter the new start time.

```
START FLOW COUNT AT
  12:30     19-JUN
```

Display 9

Example: Program Started Later Than Programmed Stop Time

This display informs you of the expired stop time. The sampler presents this display for a short time, then reverts to standby.

```
PAST STOP TIME . . .
  PLEASE REPROGRAM
```

You must access the program sequence to change the expired stop and resume times. Once you've made the changes, start the routine again with the start sampling key.

```
  . . . STANDBY . . .
10:22:34      21-JUN-04
```

3.14 Standby State

A sampler in the standby state is waiting for your instructions. From standby, you can start or resume a sampling program, access the program or configure sequences, take manual samples, and use the DISPLAY STATUS key to review program settings or the results of a sampling routine.

A sampler in standby uses a number of displays to communicate its status. Some of these displays are associated with the function of a specific key; other displays are used to notify you

that a sampling program is done, halted, or has encountered a problem. The standby state displays and valid keys are discussed below.

Standby Display – When you first turn the sampler on, the sampler "wakes up" in the standby state. The standby display, shown below, simply informs you that the sampler is in standby and reports the current time and date.

```
. . . STANDBY . . .
10:37:23    19-APR-04
```

At this point, the following keys are operable: ON/OFF, PUMP REVERSE, PUMP FORWARD, START SAMPLING, MANUAL SAMPLE, DISPLAY STATUS, and ENTER/PROGRAM.

Program Halted – A sampling program can be halted with either the STOP or EXIT PROGRAM key; if this occurs, the sampler will display the halt message shown below. If you halt the program to take a manual sample or to change a setting in the program or configure sequence, the sampler will return to standby. If this is the case, you will not be able to use the RESUME SAMPLING key.

```
. . . PROGRAM HALTED .. .
 10:37:33    19-APR-04
```

3.14.1 Operable Keys in Standby State

Keypad operations valid in Standby state are discussed below. For additional keypad descriptions, see Keypad Description on Page 3-8.

On/Off – When in the standby state, this key simply shuts the sampler off.

PUMP FORWARD and PUMP REVERSE – The PUMP FORWARD and PUMP REVERSE keys run the pump forward or in reverse until you interrupt it with the STOP key. While the pump is running, one of the two messages below is displayed, depending on the pumping direction.

```
PUMPING FORWARD . . .
```

```
PUMPING REVERSE . . .
```

When you press the STOP key, the sampler will display a message similar to the one shown here. This message indicates the total number of pump counts that occurred while the pump was running. This information can be used to set the desired number of purge counts required to purge the suction line. See Section 3.9.16. Press any key, except STOP and ON/OFF, to return to the standby display.

```
311 COUNTS FORWARD
```

Manual Sample – You can take manual samples in standby by pressing the MANUAL SAMPLE key. After you press the MANUAL SAMPLE key, the sampler will deliver the programmed sample volume. A manual sample delivers the sample volume currently entered as a programmed setting, and includes the pre-sample and post-sample purges. It will also include any programmed rinses and retries. The sampling process can be stopped with the STOP key at any time. If you press the MANUAL SAMPLE key while a sampling program is in progress, the manual sample will be counted as one of the programmed samples.

While the sample is being delivered, the sampler displays a message similar to the one below. The second line will not appear until the pump begins to pump forward to deliver the sample. The display will revert to standby after the manual sample has been delivered.

```
. . . MANUAL SAMPLE . . .
     PUMPING  200 ml
```

Start Sampling – Once you have programmed and configured the sampler, use the START SAMPLING key to run the sampling program. There are two instances where the sampler will not be able to run the program immediately. These occur when the program has been started after the programmed start time or after one or more programmed stop times.

When you press the START SAMPLING key after a program has been halted, the sampler will give you the choice between resuming the program and starting the program:

```
   [START, RESUME]
SAMPLING PROGRAM?
```

Select “START” to start the program from the beginning. Select “RESUME” to resume the program at the point at which it halted. If you do not make a selection from this display within 60 seconds, the sampler will automatically select the currently blinking response. START will re-initialize the display status memory.

Resume Sampling – To resume or restart the program, press the RESUME SAMPLING or START SAMPLING key. When you press the RESUME SAMPLING key, the program will resume at the point it was halted. The display must read “PROGRAM HALTED” for the RESUME SAMPLING key to be active. If any samples were missed during the time the program was halted, the sampler will inform you with the message shown here. The sampler will initiate one sample event if one or more sample events were missed.

```
2  SAMPLES WILL BE
     SKIPPED
```

3.14.2 Additional Displays

There are three additional displays used in the run state. These displays are discussed below.

Done – The sampler will inform you it has completed a program by displaying the message illustrated below. This message is displayed until you press any key, at which time the display will return to the standby message.

```
DONE . . .      24 SAMPLES
10:37:33         19-APR-04
```

Problem Occurred – You will be informed that a problem was encountered during the sampling routine with the message illustrated below. This display will alternate with the "DONE" display at approximately three second intervals until you press any key.

```
PROBLEM OCCURRED . . .
 PRESS DISPLAY STATUS
```

Float Tripped – 3710 Samplers use the display below to notify you that the program finished because the shut-off float was tripped. This display alternates with the "DONE" display at approximately three second intervals.

```
 FLOAT/WEIGHT TRIPPED
```

The message shown above is also used in 3700 Series refrigerated samplers. The refrigerated samplers use a weight table to determine when the composite bottle becomes full.

3.14.3 Display Status

You can access a summary of the current program settings and the results of the most recent sampling routine with the DISPLAY STATUS key. This key is valid in both the run and standby states. The summary of the program settings consists of a number of informational displays describing the settings. The results of the sampling program include information about each sample event and reports problems encountered during the program. This information remains in memory until you start another program.

You can retrieve this information with Teledyne Isco's Field Printer (no longer sold by Teledyne Isco) or a laptop computer running Teledyne Isco's Samplink software. Both methods produce two reports which contain the sampler ID, current status, program settings, and sampling results.

If a sampling routine is in progress when you press the DISPLAY STATUS key, the sampling routine will be suspended. No samples will be taken until you exit Display Status.

If the pump count reaches the number entered for the Tubing Life Warning setting, the Pump Tubing Warning will be displayed. An illustration of the warning is shown below.

```
   WARNING: REPLACE
     PUMP TUBING!
```

3.14.4 Reviewing or Printing Program Information

The sampler tracks and reports the following items:

- program start time and date
- sample volume
- source of each sample event
- cause of any missed samples
- start time of each sample event
- number of pump counts to liquid detection for each event
- time the routine was completed
- sampler ID
- current time and date
- program settings

Each of these items is illustrated in Example *Reviewing the Sampling Results*.

When you press DISPLAY STATUS, the display shown below follows the pump tubing warning. It allows you to review the program settings or sampling results.

```
[REVIEW, PRINT]
PROGRAM INFORMATION
```

Display #148

Example: Reviewing the Sampling Results

1. Press display status to view the results of the sampling program.

```
DONE . . .  24 SAMPLES
12:34:50     20-JUN-04
```

2. Select "REVIEW."

```
[REVIEW, PRINT]
PROGRAM INFORMATION
```

3. Select "RESULTS."

```
REVIEW PROGRAM [NO,
SETTINGS, RESULTS]
```

4. This display reports the start time and date of the program. Press ENTER/PROGRAM to advance to the next display.

```
PROGRAM STARTED AT
5:30      19-JUN-04
```

5. This display reports the nominal sample volume. Press ENTER/PROGRAM to advance to the next display.

```
200 ml SAMPLES
```

This display reports the number of each sample event. It also reports the source of the event; in this case, the sample was taken at the start time. Press ENTER/PROGRAM to advance to the next display.

```
SAMPLE: 1 OF 24
 SOURCE: START
```

6. This display reports the initiation time of the sample and the number of pump counts to liquid detection in the sample delivery cycle. These values indicate changes in the sampling conditions – head changes, for example. Press ENTER/PROGRAM to advance to the next display.

Example: Reviewing the Sampling Results (Continued)

```
TIME: 5:30      19-JUN-04
    COUNTS:      280
```

7. Press ENTER/PROGRAM to continue to review the information for the remaining sample events.

↓
↓

8. Press ENTER/PROGRAM to return to the "REVIEW PROGRAM" display.

```
  PROGRAM FINISHED AT
 12:00      20-JUN-04
```

9. Select "NO" to return to stand.

```
  REVIEW PROGRAM [NO,
   SETTINGS, RESULTS]
```

```
  . . . STANDBY . . .
15:39:50     19-JUN-04
```

Review – Select "REVIEW" to review the program settings and sampling results. The sampler will present the display shown below. Use this display to leave the display status procedure or to review the program settings or sampling results.

```
REVIEW PROGRAM  [NO,
 SETTINGS, RESULTS]
```

Display #150

No – Select "NO" to return to the previous operating state. If you entered display status from standby, the standby message will reappear. If you entered display status from the run state, the sampling routine will resume.

Settings – Select "SETTINGS" to review the program settings. Use the LEFT ARROW, RIGHT ARROW, and the ENTER/PROGRAM keys to move through the sampling settings. When the RIGHT ARROW or the ENTER/PROGRAM key is pressed at the last settings display, the "REVIEW PROGRAM" display will reappear.

Results – Select "RESULTS" to review the results of the sampling routine. The first display reports the time and date the sampling program started. Use the LEFT ARROW, RIGHT ARROW, and ENTER/PROGRAM keys to move through the results. If the routine was finished at the time you pressed the DISPLAY STATUS key, the last display will report the time and date the routine ended.

Print – Select "PRINT" from Display #148 to send the current status, program settings, or sampling results to the Teledyne Isco Field Printer.

☑ *Note*

The Teledyne Isco Field Printer has been discontinued and is no longer sold by Teledyne Isco. These instructions are for customers who still have Field Printers.

For information on the reports produced by the Field Printer, refer to the *Field Printer Instruction Manual*.

When you select "PRINT," Display #149 appears. Use this display to select the settings or results report. (The sampler will interrupt the reports to take a sample, if necessary.) Select "NO" to return to standby.

```
PRINT PROGRAM [NO,
SETTINGS, RESULTS]
```

Display # 149

The sampler will display one of two messages as it sends the data to the printer. The first message informs you that the transmission is in progress. The second message is a warning which informs you that the sampler is unable to detect the printer. If you see the warning message, check the cable connections between the printer and the sampler.

```
. . . PRINTING . . .
PROGRAM INFORMATION
```

```
PRINT ABORTED
NO PRINTER DETECTED!
```

3.14.5 Source of Sample Event

The display illustrated in step 5 of Example *Reviewing the Sampling Results*, on page 3-59, shows the sample event number and the source of the sample event. Source refers to the programmed or configured setting that initiated the sample event. For example, the sampler will report "TIME" as a source if the sample was taken as one of the program's time-paced samples. Eight sources are tracked and reported for a composite sampler:

Time - The sample event was one of the program's time-paced samples.

Flow - The sample event was one of the program's flow-paced samples.

Start - The sample event was initiated at the program's start time.

Resume - The sample event was initiated to compensate for a missed sample which should have occurred while the sampler was halted. If more than one sample event was missed, only one sample will be taken.

Power - The sample event was initiated to compensate for a missed sample which should have occurred while the sampler was without power. If more than one sample was missed, only one sample will be taken.

Enable - The sample event was initiated when the sampler became enabled by a device connected to pin F of the flow meter connector, generally an Isco Flow Meter or Liquid Level Actuator. This source is also reported when the sample was initiated at a programmed resume time. Two different configure option set-

tings control this event: the Sample Upon Enable setting in the Enable Pin configure option and the Sample at Resume setting in the Sampling Stop/Resume configure option.

Manual - The sample event was initiated with the MANUAL SAMPLE key and was counted as one of the programmed sample events.

Disable - The sample event was initiated when the sampler became disabled by a device connected to pin F of the flow meter connector. This source is also reported when the sample was taken at a programmed stop time. Two different configure option settings control this event: the Sample Upon Disable setting in the Enable Pin configure option and the Sample at Stop setting in the Sampling Stop/Resume configure option.

3.14.6 Error Messages and Missed Samples

The probable cause of any missed sample is reported after the sample number/source display. A missed sample display is illustrated below.

```
SAMPLE MISSED:
NO LIQUID DETECTED!
```

Ten causes are tracked and reported:

Pump "STOP" Key Hit! - The sampler was halted with the STOP key during the sample event.

Pump Jammed! - The sampler was unable to take the sample because the pump jammed.

Started Too Late! - The sampling routine was started after the programmed start time for the first sample. This message is reported for all samples skipped because of an expired start time.

Program Halted! - The sampling routine was interrupted by the STOP or EXIT PROGRAM key when the sample event was to occur.

Power Lost! - The sampler was unable to take the sample because the sampler's power source was disconnected.

Sampler Inhibited! - The sampler was prevented from taking the sample by an inhibit signal sent to the sampler by an Isco Flow Meter or a Liquid Level Actuator.

Float/Weight Tripped! - 3710 Samplers detect overflow with a liquid level float located at the mouth of the composite bottle. If the liquid level of the bottle raises the float past the trip point, the sampler will interrupt the sample event and record the "Float/Weight Tripped" condition.

No More Liquid! - The sampler was unable to take the sample because, in attempting to take the sample, the sampler pumped all liquid from the flow stream.

No Liquid Detected! - The sampler was unable to take the sample because no liquid was detected.

Sampler Shut "Off"! - The sampler was unable to take the sample because it was halted with the ON/OFF key during the sample event.

3.15 Run State

A sampler in the run state is executing the sampler's instructions according to the settings you've entered in the program and configure sequences.

To start a sampling program and place the sampler into the run state, press the START SAMPLING key. While running the sampling program, the sampler will present a number of displays which allow you to monitor the sampler's progress. The displays are listed with a brief explanation in Table 3-7, on page 3-63.

If a problem is encountered while running a sampling routine which has resulted in missed samples, an asterisk will appear in the lower right corner of the display, as illustrated below.

```
     SAMPLE 17 OF 48
AT  6:00        5:42:33 *
```

There are two instances where the sampler will enter the run state after the START SAMPLING key is pressed, but will not begin the sampling program. If the sampler is acting as a slave in a master/slave configuration, the sampler will not begin the program until it receives an enable signal transmitted by the master sampler. If the sampler is interfaced with a Liquid Level Actuator, or other equipment capable of transmitting an inhibit signal, the sampler will not begin the program until the inhibit signal is suspended. The sampler will use one of the following displays to inform you of these conditions.

```
MASTER/SLAVE MODE . . .
   WAITING FOR MASTER
```

```
   SAMPLER INHIBITED!
 10:32           20-APR
```

Table 3-7 Run State Displays: Composite Sampling

`SAMPLE 1 OF 12` `AT 6:00  5:43:33`	Indicates the sample number of the next sample and the total number of samples for time-paced routines. The current time is shown in the lower right corner.
`SAMPLE 1 OF 12` `AFTER 10 PULSES`	Indicates the sample number of the next sample and the total number of samples for flow-paced routines.
`SAMPLE 2 OF  ???` `AT 6:00  5:43:33`	Indicates the sample number of the next sample. The question marks indicate the sampler will use the float shut-off to terminate the routine. The second line reports the scheduled time of the upcoming sample event and the current time.
`SAMPLE 1 OF ???` `AFTER 100 PULSES`	Indicates the sample number of the next sample. The question marks indicate the sampler will use the float shut-off to terminate the routine. The second line reports the number of flow pulses remaining until the next sample event.
`SAMPLE 2 OF 12` `PUMPING  200 ml`	Indicates a sample in progress.

3710 Portable Samplers

Section 4 Options and Interfacing Equipment

4.1 Introduction

This section presents information regarding the major options available with the 3710 Sampler. The following sections present a general description of the options.

- Flow Meter Connections
- Interface Devices
- Master/Slave Connections
- 1640 Liquid Level Actuator

4.2 Connection to External Devices

The 3700 Series Samplers can collect samples on a flow-paced basis using flow inputs from an external flow meter. The 3710 requires a 5-to-15 VDC pulse of at least 25-millisecond duration to register a flow pulse. **Open-channel** flow meters are connected to the sampler by attaching a flow meter connect cable to the flow meter connector located on the rear of the sampler. **Closed-pipe** flow meters are connected to the sampler's Flow Meter port using the Teledyne Isco 4-20 mA Input Interface device (see Appendix B Accessories).

Your sampler has an additional connector, labeled "PRINTER," used to connect the sampler to an Isco Field Printer or laptop computer. Both the flow meter connector and the printer connector use the same 6-pin configuration. The printer cable connector accepts both the connector from the field printer and a cable from a field computer or a laptop computer running the Samplink software.

Figure 4-2 shows a diagram of the pin locations on the 6-pin connector. Tables 4-1 and 4-2 show the pinouts required for connecting an external device to the sampler. Refer to the instruction manual of the flow meter being used for further details.

> ☑ ***Note***
>
> The Field Printer has been discontinued and is no longer sold by Teledyne Isco.

4.2.1 Isco Flow Meters and Flow Loggers

Connect cables to connect the 3710 Sampler to an Isco 4200 Series flow meter, 4100 series flow logger, or 2100 series flow module, are available. Refer to Appendix B for details. To make the connection, attach the appropriate cable connector to the flow meter according to directions in the flow meter instruction manual, and attach the other connector to the 6-pin flow meter connector on the rear of the sampler.

Figure 4-1 Flow Meter Connection

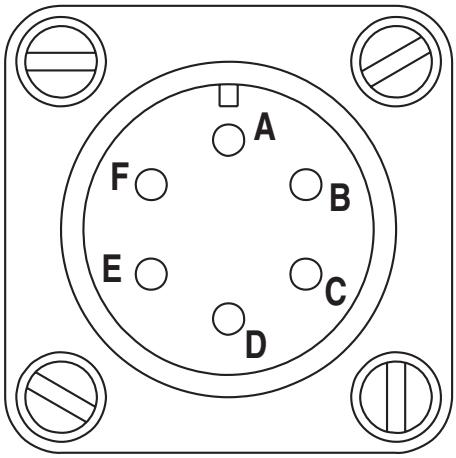


Figure 4-2 Pin Locations for 6-pin Connector

Table 4-1 Flow Meter Connector Wiring	
A	+12 VDC
B	Common
C	Flow Pulses In
D	Bottle Number Out Master/Slave Out
E	Event Mark Out
F	Inhibit In

Table 4-2 Printer Connector Wiring	
A	+12 VDC
B	Common
C	Printer Source
D	Transmit
E	Receive
F	NC

4.2.2 Non-Isco Flow Meters

You can connect certain non-Isco Flow meters directly to a 3710 for flow-paced sampling. The flow meter must have an isolated contact closure of at least 25 milliseconds to provide acceptable flow pulses to the sampler. The frequency of the contact closure must be directly proportional to total flow. Teledyne Isco offers both a connector and cable clamp to connect a non-Isco Flow meter to the 3700 samplers. Connect the flow meter pulse output to the A and C pins of the 6-pin Flow Meter connector on the 3710 (Figure 4-2). Refer to your flow meter's instruction manual for further details.

Teledyne Isco also offers a connector prewired to a 22-foot (6.7-meter) cable that terminates in two wires. The black wire is connected to pin A; the white wire to pin C.

Note that you will be unable to communicate anything other than the flow pulse contact closure with a non-Isco Flow meter. The non-Isco Flow meter will not be able to interpret event and bottle number information.

If the flow pulse generated by the contact closure on the flow meter is not compatible with Teledyne Isco's standard, contact Teledyne Isco's Special Products Department for an appropriate interface device.

4.2.3 4-20 mA Flow Signals

The 3710 Sampler can also be used with flow meters having other types of outputs, for example, a 4 to 20 mA output directly proportional to the flow rate. However, these flow meters require a special interface device to convert their output signal to one compatible with the 3710 sampler.

The **4–20 mA Sampler Input Interface** converts 4 to 20 mA output signals from both non-Isco Flow meters and closed-pipe flow meters to flow pulses acceptable to the 3710 Sampler.

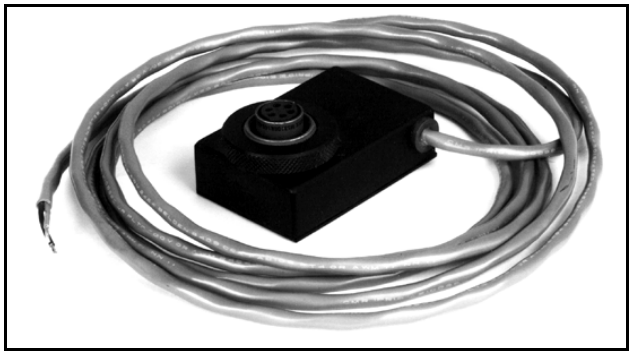


Figure 4-3 4-20 mA Sampler Input Interface

4.2.4 1640 Liquid Level Actuator

The 1640 Liquid Level Actuator is a device used to begin a sampling routine when the liquid level of the sample flow stream reaches a predetermined height. The actuator is used to inhibit sampling according to flow levels; i.e., if the level of the flow stream falls below the actuator's probe, the actuator will inhibit sampling until the level again rises to contact the probe.

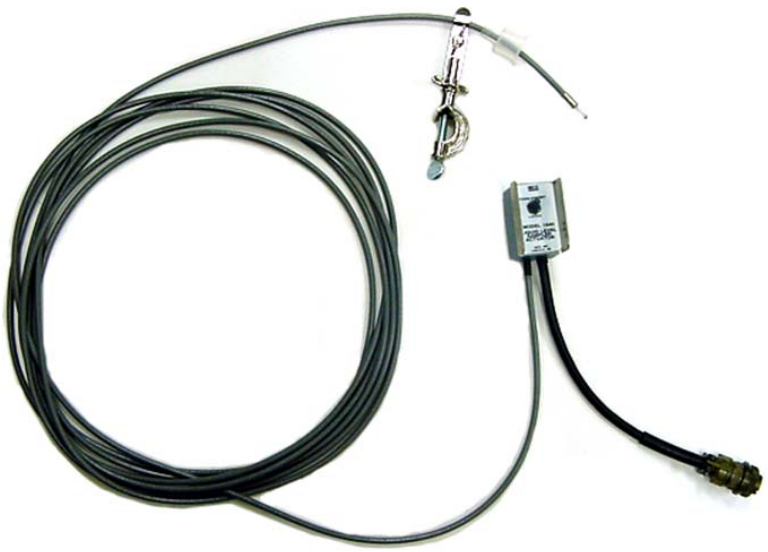


Figure 4-4 1640 Liquid Level Actuator

The actuator can be set to control the sampler in two modes:

Latch Mode – The sampler continues the sampling routine even though the liquid level has receded and liquid no longer contacts the sensor.

Toggle Mode – The sampler will halt the routine when the liquid ceases to contact the sensor.

To connect the actuator to the sampler, attach the actuator cable to the flow meter connector. Refer to Figure 4-1 for the location of the flow meter connector. Refer to the Liquid Level Actuator Instruction Manual for additional information.

The sampler must be configured to respond to the actuator. Refer to the discussion of the Enable Pin configure option (Section 3.9.14, on page 3-33).

4.3 Master/Slave Connections

Using samplers in master/slave pairs allows you to conduct continuous sampling: while one sampler performs a sampling routine, the other sampler awaits a command to begin sampling. Installing two samplers as master and slave in manholes allows you to double the sampling capacity, thereby reducing the number of visits to the manhole.

The samplers must be connected with the Master/Slave Interconnect Cable by attaching the cable to the flow meter connector on both samplers. Both samplers must be configured to be in the master/slave mode. Enabling the master/slave mode is discussed in Section , on page 3-33. When installing the master/slave pair, you must press the START SAMPLING key on both machines to place both machines in the run state. The first machine started becomes the master. After the master completes its routine, it can be serviced and restarted.

After servicing, if the sampler is not started again, the master/slave cycle will halt after the second sampler finishes its routine. The samplers will not reverse roles unless both are in the run state.

While the master sampler is performing a sampling routine, it sends an inhibit signal out on pin D. The slave sampler, receiving the signal on pin F, remains dormant until the master sampler completes its routine. At this point, the samplers reverse roles.

3710 Portable Samplers

Section 5 Routine Maintenance

5.1 Introduction

This section covers routine maintenance of the sampler. It includes the following sections.

- Cleaning the Sampler
- Cleaning Protocols for Priority Pollutants
- Replacement of Pump Tubing
- Replacement of Suction Line
- Changing the Internal Desiccant

5.2 Cleaning the Sampler

The following sections contain instructions for cleaning the sampler case, tubing, and bottles. Cleaning protocols for priority pollutants are given. Disassemble the sampler for cleaning by following the instructions found in Section 2.1, on page 2-1.

5.2.1 Case

The top cover and sample bottle base can be cleaned with warm soapy water or by spraying them with a hose. The center section can be cleaned in a similar manner provided that a power source is attached to the 12 VDC connector and the flow meter connector is tightly capped.

5.2.2 Tubing

The suction line and pump tubing can be cleaned by placing the end of the suction line in a cleaning solution and pumping this solution through the tubing system using the PUMP FORWARD and PUMP REVERSE keys. Follow with a clean water rinse.

5.2.3 Sample Bottles

The bottles have a wide mouth to facilitate cleaning and can be washed with a brush and soapy water or washed in a dishwasher. The glass bottles can be autoclaved; however, the plastic lids and bottles should **not** be autoclaved.

5.3 Cleaning Protocols for Priority Pollutants

The following sections are excerpted from U.S. Environmental Protection Agency Publications EPA-600/4-77-039 (“Sampling of Water and Wastewater” by Dr. Phillip E. Shelley) to provide an example of sampler cleaning procedures for priority pollutants.

Proper Cleaning – Proper cleaning of all equipment used in the sampling of water and wastewater is essential to ensuring valid results from laboratory analysis. Cleaning protocols should be developed for all sampling equipment early in the design of the wastewater characterization program. Here also, the laboratory analyst should be consulted, both to ensure that the procedures and techniques are adequate, as well as to avoid including practices that are not warranted in view of the analysis to be performed.

Cleaning Examples – As an example, Lair (1974) has set down the standard operating procedures for the cleaning of sample bottles and field procedures equipment used by USEPA Region IV Surveillance and Analysis field personnel engaged in NPDES compliance monitoring. They are reproduced below for a typical automatic sampler and related sampling equipment.

Teledyne Isco Glass Sample Bottles

1. One spectro-grade acetone rinse.
2. Dishwasher cycle (wash and tap water rinse, no detergent).
3. Acid wash with at least 20 percent hydrochloric acid.
4. Dishwasher cycle, tap and distilled water rinse cycles, no detergent.
5. Replace in covered Teledyne Isco bases.

Suction Line (1/4- or 3/8-inch Vinyl)

1. Do not reuse sample tubing. No cleaning required. New sample tubing is to be used for each new sampling setup.
2. Use PTFE tubing where samples for organics are to be collected.

Teledyne Isco Pump Tube

1. Rinse by pumping hot tap water through tubing for at least 2 minutes.
2. Acid wash tubing by pumping at least a 20 percent solution of hydrochloric acid through tubing for at least 2 minutes.
3. Rinse by pumping hot tap water through tubing for at least 2 minutes.
4. Rinse by pumping distilled water through tubing for at least 2 minutes.

PTFE Tubing

1. Rinse twice with spectro-grade acetone.
2. Rinse thoroughly with hot tap water using a brush if possible to remove particulate matter and surface film.
3. Rinse thoroughly three times with tap water.
4. Acid wash with at least 20 percent hydrochloric acid.
5. Rinse thoroughly three times with tap water.
6. Rinse thoroughly three times with distilled water.
7. Rinse thoroughly with petroleum ether and dry by pulling room air through tubing.
8. Dry overnight in warm oven (less than 150• F), if possible.
9. Cap ends with aluminum foil.

5.4 Pump Tubing

The pump tube serves two functions: it is a pump tube in the peristaltic pump and a distribution tube, routing the sample liquid from the pump outlet to the sample bottle. The pump tube consists of a single piece of medical grade Silastic™ silicone rubber tubing. Medical grade tubing is used because of its superior mechanical properties and because it does not contain any organic materials. Non-medical grade silicone rubber tubing can contain organic vulcanizing agents. During the vulcanizing process, these agents are converted into other compounds which can be leached into the sample. The medical grade silicone rubber tubing supplied by Teledyne Isco for use with the 3710 Sampler will **not** contribute any organic material to the sample.

Replacement pump tubes for the standard sampler must be 36 inches (91.5 cm) long; 33½ inches (85.1 cm) long for the compact sampler.

5.4.1 Inspection of Pump Tubing

The pump tubing is extremely durable. However, the constant mechanical strain placed on the tubing by the peristaltic action of the pump will eventually cause the tubing to fatigue and fail. Inspect the pump tubing periodically for wear inside the pump by removing the cover. Check the tubing for cracks where the pump roller compresses the tubing. Replace it with a new pump tube, if necessary.

The inspections should be fairly frequent when the liquid being sampled contains a high percentage of suspended solids. If the liquid is relatively free of solids, the inspections can be less frequent. The Tubing Life configure option reports the number of pump counts elapsed during the life of the pump tube.

> ☑ ***Note***
>
> The importance of regular tubing replacement cannot be overstated. The key is to replace the tube before failure, not after. When a pump tube ruptures, grit and other abrasive debris can be driven into the pump shaft seal. Over time, this abrasive material will degrade the pump seal, jeopardizing the NEMA 4x 6 rating of the controller.
>
> Failure to maintain the pump tube may result in permanent damage to the sampler. Check the condition of the pump tube regularly and if the tube shows signs of fatigue or wear, replace it immediately. A properly maintained sampler will provide the years of reliable service that is expected of a Teledyne Isco Sampler.

The amount of tubing (13.5 inches) used in the pump is less than half the total length of the pump tube. In some cases, when the tube has not been damaged to the point of leaking, the tube can be used twice by simply turning it around.

> **☑ Note**
>
> The black bands used to assist you in correctly positioning the tubing in the pump and detector are placed on one end only. If you turn the tubing around, you will not be able to use the bands for reference.

5.4.2 Removing the Pump Tubing

To remove the tubing:

1. Disconnect power from the unit.

> **⚠ WARNING**
>
> **Be sure power is disconnected from the unit before exchanging the pump tubing. The pump is extremely powerful. If the sampler activates the pump while you are manipulating the tubing, serious injury can result.**

2. Separate the center section from the remainder of the sampler (as described in Section 2.1, on page 2-1), and turn the center section over.
3. Remove the tube from the float cage by pulling the tube out of the pump tube guide, indicated in Figure 5-1, on page 5-5.
4. Turn the center section back over, and detach the outer case of the liquid detector by loosening the two captivated thumbscrews shown in Figure 5-2. Pull the tubing away from the detector.
5. Remove the outer pump lid by loosening the four captivated thumbscrews indicated in Figure 5-2. This will expose the pump tubing which is squeezed between the pump rollers and the curved surface of the inner pump lid as shown in Figure 5-3.
6. Extract the tubing from the pump. The pump rollers can be rotated manually to facilitate the removal of the tubing. Before manually rotating the rollers, be sure the sampler is turned off. After the tubing is removed, thoroughly clean the interior of the pump case.
7. Remove the suction line, if attached, as described in Section 5.5.

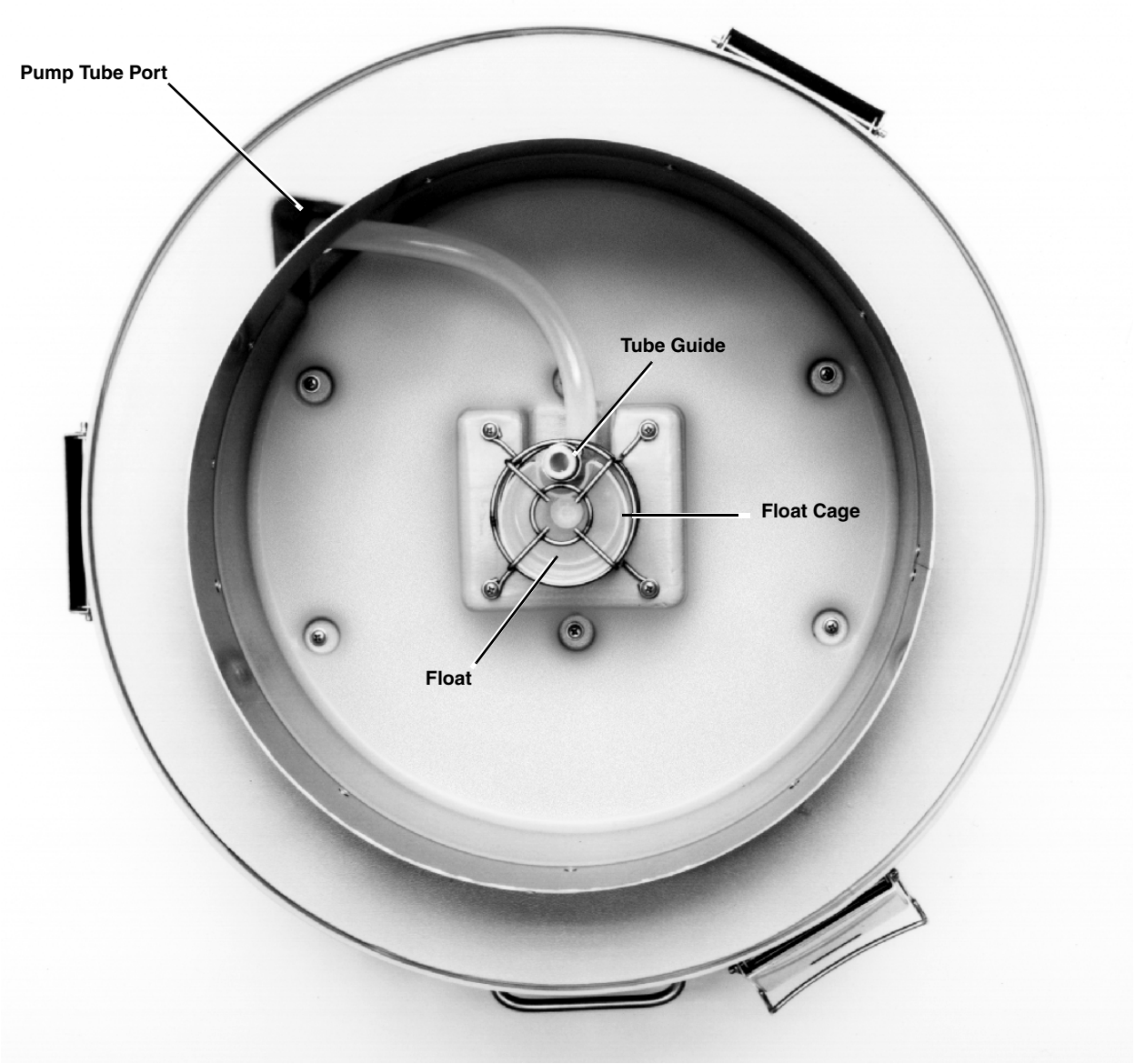


Figure 5-1 Center Section: Removing the Pump Tube (Standard center section shown)

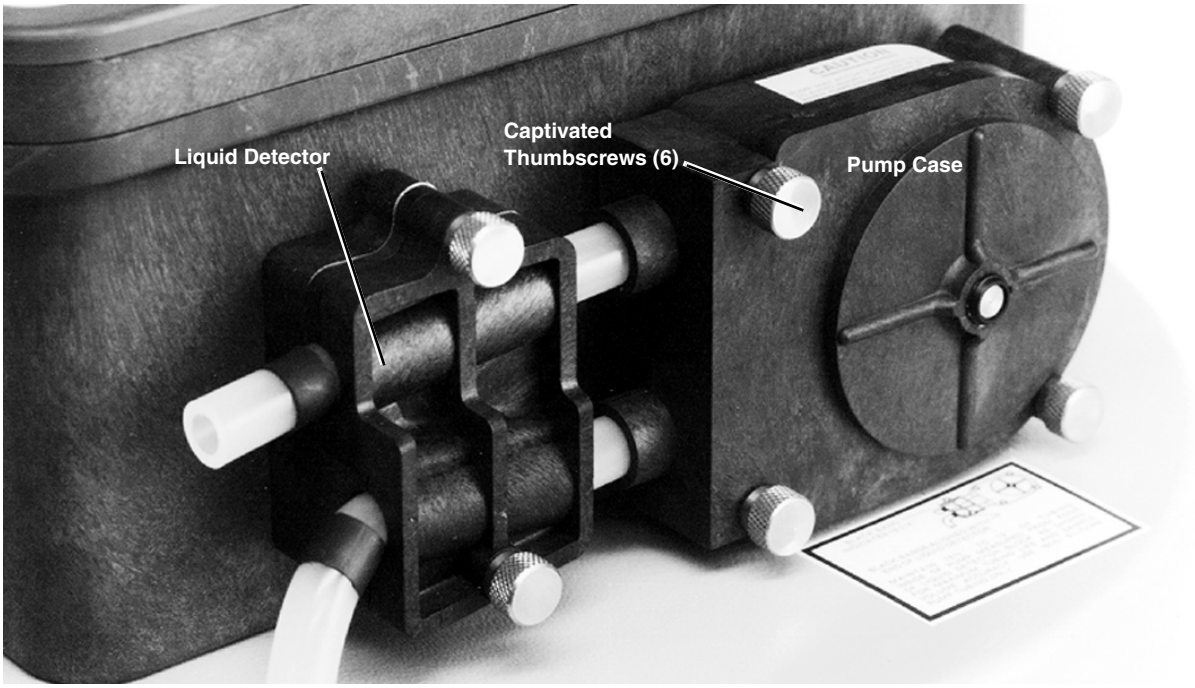


Figure 5-2 Liquid Detector and Pump Housing

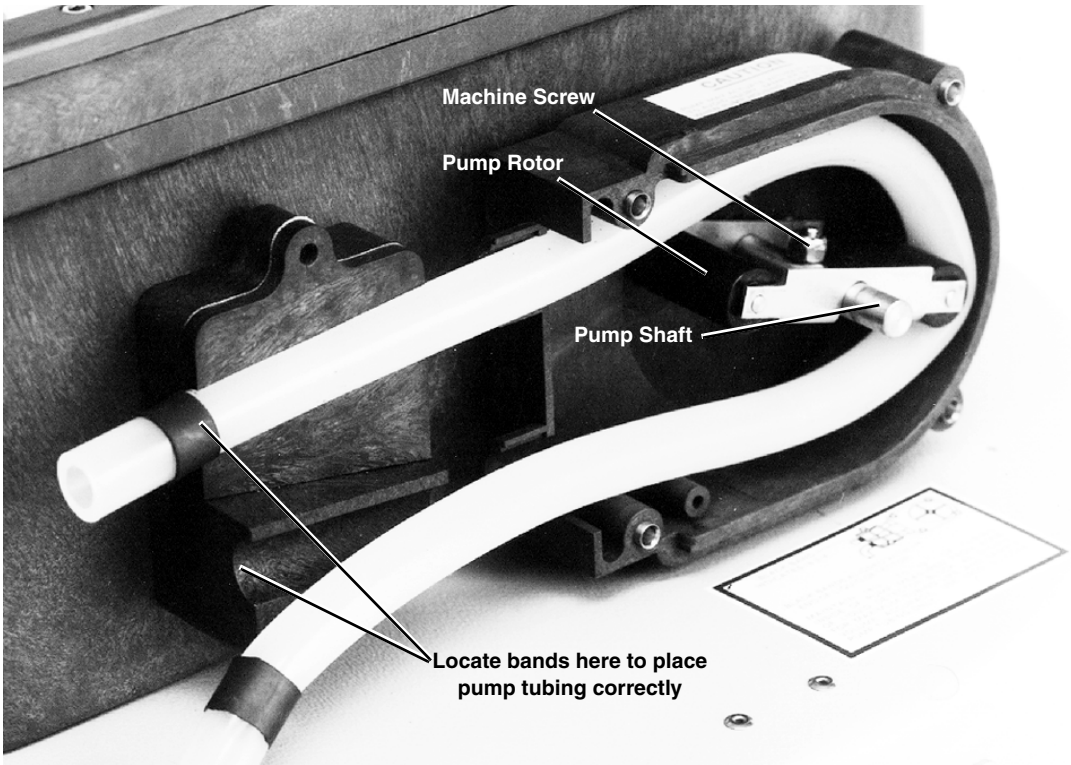


Figure 5-3 Interior of Liquid Detector and Pump Housing

5.4.3 Installing a New Pump Tube

The steps below outline the procedure needed to install a new pump tube.

⚠ WARNING

Pump may actuate without warning. To avoid injury, sampler must be off when pump housing cover is removed for inspection or tubing replacement.

1. The pump tube is marked with two black bands which locate the tubing correctly in the detector and pump. To prolong the tubing life, insure efficient pump operation, and accurate samples, place the tubing in the pump correctly.
   Facing the liquid detector, position the inner edge of the end band against the upper left inlet of the liquid detector. Place the inner band at the lower outlet of the liquid detector. Figure 5-3 shows the correct placement of the tubing.
2. Slip the pump tubing under the rollers so that the pump tubing does not interfere with the installation of the outer pump lid.
3. Replace the outer pump lid and tighten the four thumbscrews.
4. Re-check the position of the marker bands and adjust the tubing if the position of the bands indicate the tubing has slipped.
5. Replace the outer case of the liquid detector. *For proper operation of the liquid detector, tighten the thumbscrews securely.*
6. Feed the free end of the tube down through the pump tube port in the center section.
7. Turn the center section over again, and feed the end of the tube into the pump tube guide in the float cage as shown in Figure 5-1. The discharge end of the tube should be flush to 1/16-inch below the end of the guide.
8. Re-install the suction line, as described in Section 5.5.
9. Inspect the length of exposed tube under the center section. There should be no excessive slack in this tube; it should continuously slope downward from the bottom of the center section to the point where it enters the float cage. This prevents low spots in the tube which might not completely drain. If there is excessive slack, adjust the tube under the center section by pulling it from the pump-tube port.
10. Reset the Pump Tube count to zero. Refer to the discussion of Section 3.9.17, on page 3-36.

5.5 Suction Line

The suction line may be worn, cut, contaminated, or otherwise damaged; it should be periodically inspected for damage. In critical sampling, it may be necessary to replace the suction line between sampling programs to avoid cross contamination. When sampling site conditions change, it may be necessary to replace the suction line with a different diameter or type of line (vinyl or PTFE).

5.5.1 Replacement Vinyl Line

Replacement Vinyl Line – Teledyne Isco offers two forms of replacement vinyl suction lines. First, a complete suction line, with strainer and tube coupling, is available in 10-foot and 25-foot lengths for each of the 1/4-inch and 3/8-inch ID (Inside Diameter) vinyl suction lines. Second, bulk suction line in the 1/4-inch ID and 3/8-inch ID vinyl tube is available in 100 and 500 foot rolls. Cut the bulk suction line to even foot lengths.

> ☑ ***Note***
>
> The vinyl suction tubing contains a very low PPM (parts per million) level of phenols. If this affects your samples, use the PTFE suction line.

5.5.2 Vinyl Suction Line

The following sections discuss the replacement of the complete suction line-strainer assemblies, the sizing of the suction line, and the assembly and installation of the bulk tubing.

Remove the suction line from the pump tubing by detaching the tube coupling, see Section 2.4.1.

If you must use a completely new suction-line strainer assembly of the standard 10- or 25 foot-length, install it as described in Section 2.4.1.

Bulk Suction Line – If you are using bulk suction line to replace the old line, detach the old line from the tube coupling and remove the strainer. Cut the new suction line to the desired length in 1-foot increments. The line must be between 3 and 99 feet long.

To ensure accurate sample volumes, be sure that the line is cut in 1-foot increments and that the line length is correctly entered in the Suction Line configure option. Screw the strainer into the new suction line. You can now install the new suction line in the pump as described in Section 2.4.1.

5.5.3 PTFE Suction Line

Remove the suction line from the pump by loosening the clamp that secures the line to the pump tube and pulling the suction line out of the pump tube. If you must use a new suction line (either with or without the optional stainless steel strainer), install it as described in Section 2.5. To install the optional stainless steel strainer, heat the end of the suction line to make it more flexible, then carefully screw the strainer's threaded connector into the suction line.

Replacement PTFE Line – Teledyne Isco offers 3/8-inch ID PTFE suction line in lengths of 10 and 25 feet.

5.6 Internal Desiccant

A humidity indicator, labeled "INTERNAL CASE HUMIDITY," is located in the lower left corner of the control panel. It indicates the amount of moisture present inside the control box. The paper indicator is blue in a dry state.

The control box is a completely sealed unit. (The control box does not need to be opened during normal operation.) The desiccant should absorb any moisture which may accumulate in the control box. Thus, the humidity indicator should remain blue under normal conditions. If moisture does accumulate, the numbered areas on the indicator will turn light pink or white, starting with the area numbered "20." This indicates that the relative humidity inside the control box exceeds 20%. As more moisture accumulates, the areas numbered "30" and "40" will turn light pink or white, indicating relative humidities of 30% and 40%.

⚠ CAUTION

The control box contains electronic circuitry which may be damaged by static discharge. Open the control box only in a static free environment.

If the 30% area of the humidity indicator turns light pink or white, the control unit should be opened, inspected for leaks, and the desiccant renewed. This is done by unscrewing the ten screws Figure 5-4, on page 5-10 around the outer rim of the control box bezel, and carefully lifting the frame and cover off the control box.

⚠ CAUTION

Desiccant may produce irritating fumes when heated. Observe the following precautions:

- Use a vented oven in a well ventilated room.
- Do not remain in the room while recharging is taking place.
- Use the recommended temperature.

There have been reports of irritating fumes coming from the desiccant during reactivation. While our attempts to duplicate the problem have been unsuccessful, we still urge you to use caution.
Material Safety Data Sheets are provided in Appendix G.

5.6.1 Renewing the Desiccant

The desiccant is renewed by first removing the bags of desiccant from the control box, as shown in Figure 5-5, on page 5-11. Then place a sheet of brown paper on a flat metal sheet. Do not stack the bags on top of each other or allow them to touch. Place in a vented, circulating forced air, convection oven in a well vented room. Allow two inches of air space between the top of the bags and the next metal tray above the bags. Keep the tray a minimum of 16 inches from the heating element. Heat the bags at a temperature of 240° to 250° F (116° to 121° C) for 12 to 16 hours. At the end of the time period, the bags should be immediately removed and placed in an airtight container for cooling. The

desiccant will be recharged to approximately 80% to 90% of its previous capacity. After repeated recharging, the desiccant bag may require replacement. Replacement bags of desiccant are available from Teledyne Isco.

Some bags will have the temperature and time for recharging printed on the bag. If they differ, use the time and temperature printed on the bag.

Reassemble the controller by placing the renewed desiccant in the tray. Reconnect any disconnected wiring or grounding straps between the control box and panel. Before reinstalling the cover, coat the cover's gasket with a light film of silicone grease to seal the control box. Tighten the ten screws which hold the control box cover and bezel in place using an even cross-torquing pattern.

Figure 5-4 Location of 10 Screws on Control Box Bezel

Figure 5-5 Control Box Internal Desiccant

3710 Portable Samplers

Section 6 Servicing

This section presents servicing information. The following sections are included:

- Servicing the 3710 Controller
- Removal of the Control Box
- Removal of the Pump Gear Case Assembly
- Precautions for Servicing CMOS circuitry
- Circuit Boards
- Sample Event Cycle and Delivery of Sample Volumes

To view schematic drawings of the circuit boards discussed in this section, first find the serial number on your controller, then go to our web site, **www.isco.com**. Go to Training and Support and select Product Support. Click Automatic Wastewater Samplers. In the left margin, click Schematics. Enter the serial number of your instrument, then click Get Schematics to view a list of PDF files that contain the available schematics.

6.1 3710 Controller

The electronic circuitry of the 3710 Sampler is solid-state and its reliability is high. If the unit should fail to operate properly, items such as a broken or intermittent connection in the power cable or wiring harness should be suspected.

6.1.1 If Serious Problems Occur

If the sampler fails to operate properly, call the Teledyne Isco Customer Service Department. The service department will provide information on how to return the sampler to the factory for repair. For example, the pump assembly or control box can be removed and returned separately for servicing. Contact information can be found at the front of this manual.

6.1.2 Removal of the Control Box

Should there be a problem with the sampler which requires factory service, it is usually easiest to return only the control box for repair. The control box is removed from the sampler in the following manner.

1. Disconnect the power source from the control box.
2. Separate the center section from the sampler following the procedure described in Section 2.1, on page 2-1.
3. Remove the suction line from the pump, and turn the center section over, as shown in Figure 6-1, on page 6-3.
4. Pull the pump tube out of the float cage assembly, and feed it out of the pump tube port in the center section.

5. The control box may then be removed by unscrewing the six screws indicated in Figure 6-1, and lifting the center section off the control box.
6. Screw the six screws and their lock washers into the control box to prevent losing them.
7. Re-attach the liquid detector lid and pump lid to prevent their loss.

6.1.3 Packing

When returning the control box to the factory, be sure to pack it securely. Please include a detailed note explaining the problem.

6.2 Access to Electronic Components

To gain access to the electronic components housed in the control box:

1. Disconnect the power source from the sampler.
2. Remove the ten screws around the outer edge of the control box bezel.
3. Lift the cover and frame off the control box and turn it over, as shown in Figure 6-2, on page 6-3.
4. The control box cover assembly may be disconnected from the control box lower section by disconnecting the five connectors, and the long grounding strap between the control box and panel.
5. The main circuit board assembly of the 3710 Sampler is protected by an aluminum shield.
   To remove this shield, unscrew the screws (4) located in each corner of the shield, and the stop nut that holds the short grounding strap. Lifting the shield off will reveal the main circuit board shown in Figure 6-3, on page 6-4.
6. To remove the circuit board assembly from the control box cover, unscrew the four hex threaded stand-offs and the phillips head screw, indicated in Figure 6-3. The circuit board may now be pulled away from the control box cover.
7. To completely disconnect the circuit board assembly from the cover, disconnect the connector shown in Figure 6-3.

Reverse the steps to reassemble the controller. Ensure that all hardware and connections are secure.

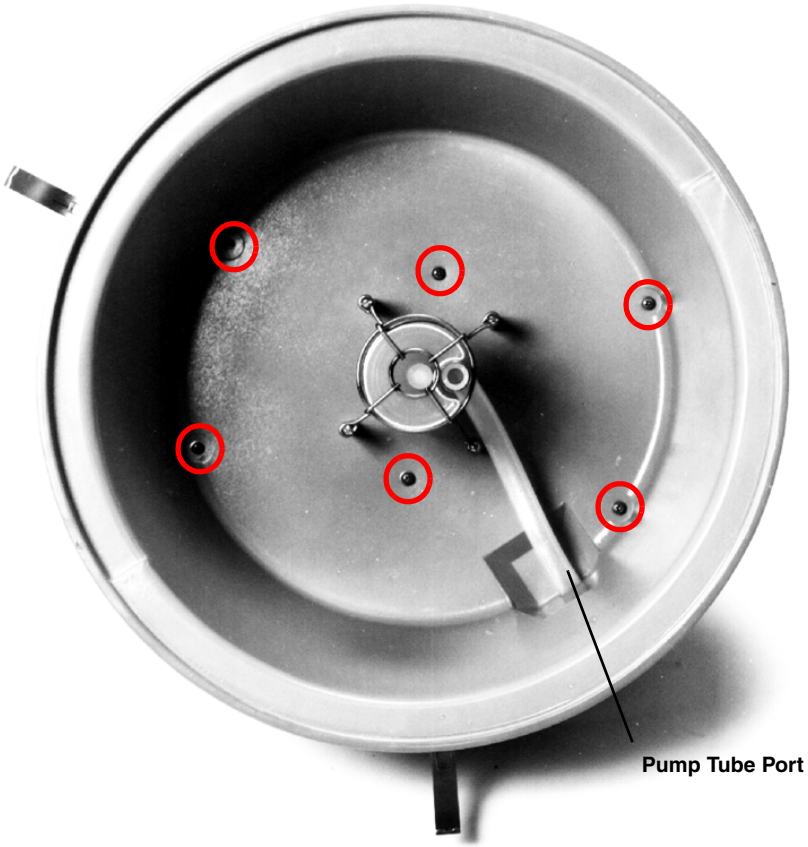


Figure 6-1 Removing the Control Box (by unscrewing the 6 screws)

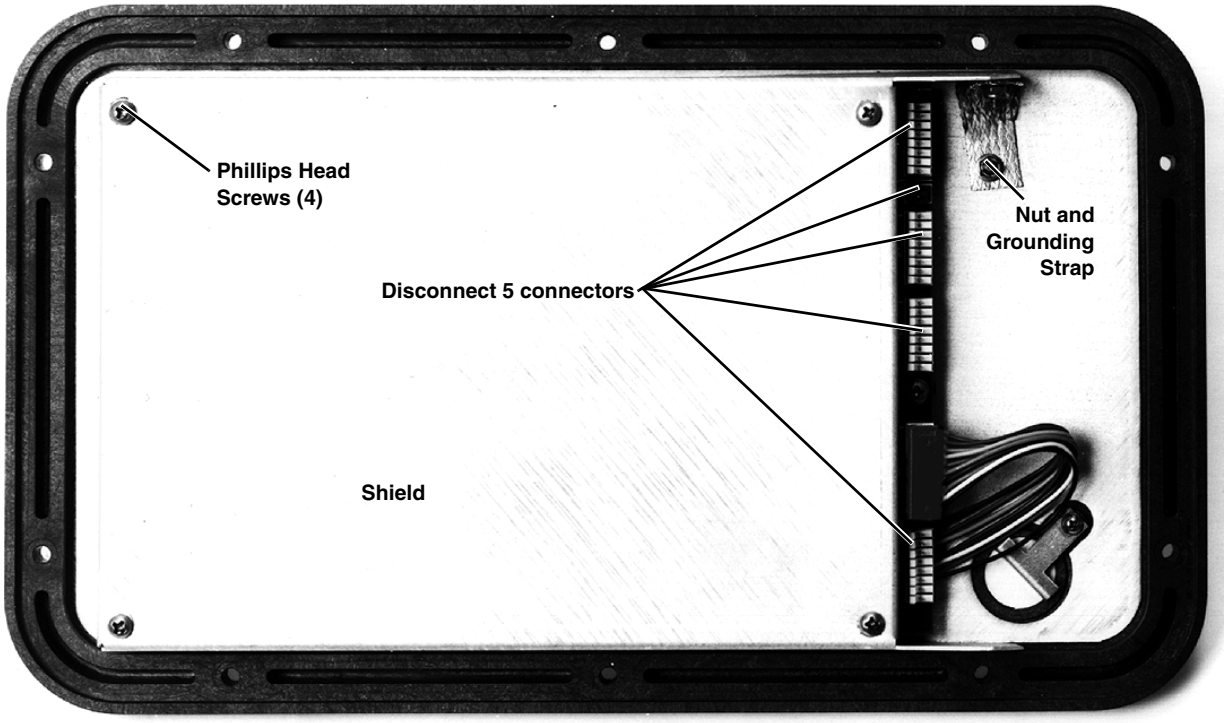


Figure 6-2 Underside of the Control Box Cover

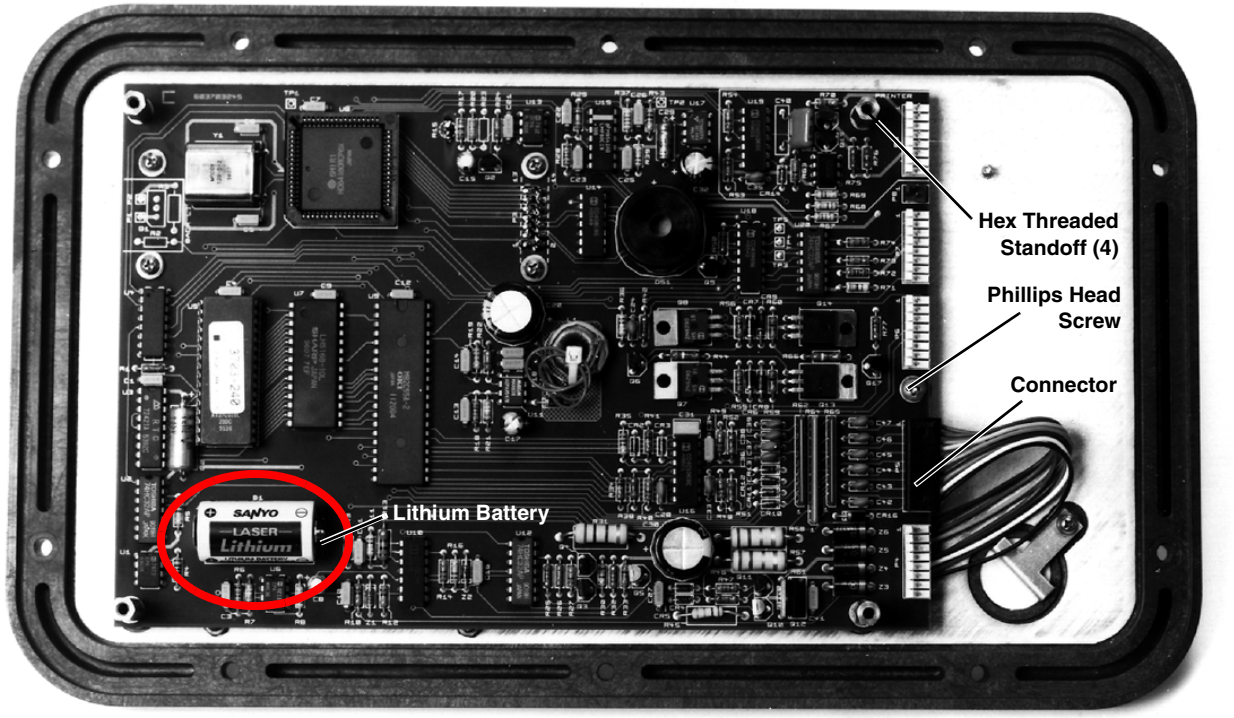


Figure 6-3 Main Circuit Board

6.2.1 Removal of the Pump Gear Case Assembly

The pump gear case assembly is located in the lower section of the control box. To gain access to the lower section of the control box, follow the instructions in Section 6.2.

Use the following steps to remove the pump gear case.

1. Disconnect power from the unit.
2. Remove the two nuts, the screw, and the grounding strap (see Figure 6-4).
3. Lift the plastic tray straight up out of the control box.
4. Remove the liquid detector lid and the pump lid by loosening the captivated thumbscrews on the pump exterior. Figure 5-2, on page 5-6, shows the location of the thumbscrews.
5. Remove the pump tubing from the interior of the pump.
6. Remove the pump rotor by loosening the machine screw and locknut attaching the rotor to the pump shaft. Figure 5-3, on page 5-6, shows the location of the machine screw.
7. Rotate the rotor until you can reach the screw with a screwdriver inserted through the pump case inlet sleeve. Loosen the screw.
8. Slide the rotor off the pump shaft.
9. Remove the case by unscrewing the four screws on the back of pump's inner case.

10. Unscrew the stop nut that attaches the grounding strap to the shut-off microswitch assembly.
11. Lift the pump gear case assembly out of the control box.

Reverse the steps to reassemble the controller. Ensure that all hardware and connections are secure.

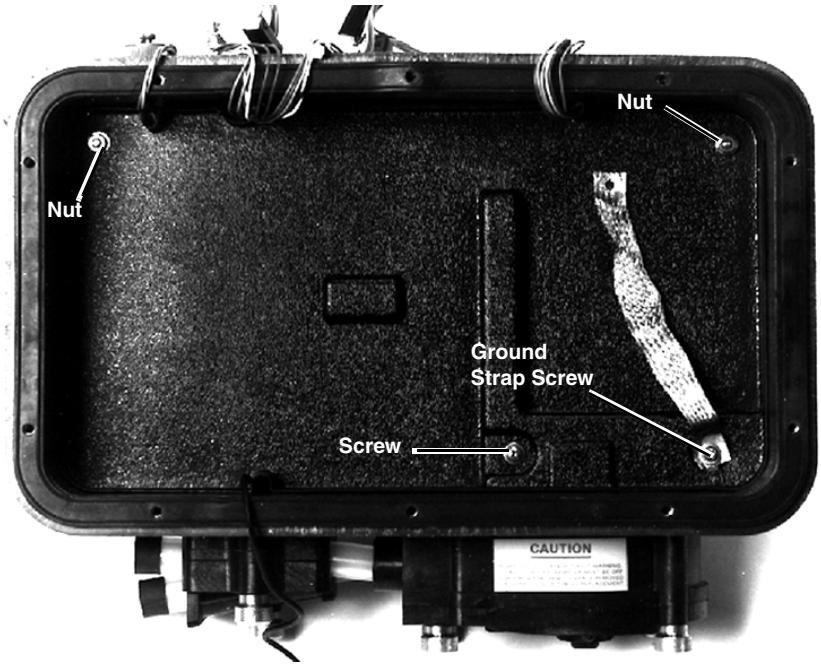


Figure 6-4 Control Box Tray Removal

6.3 Precautions for Servicing CMOS Circuitry

Most of the circuitry in the 3710 Sampler is made up of CMOS components. Because of the oxide gate structure of these devices, they are extremely susceptible to destruction caused by the discharge of static electricity through their inputs.

⚠ CAUTION

Disconnect power from the controller when working on the unit. Keep yourself grounded when handling disassembled equipment.

6.4 Preliminary Electronics Troubleshooting

Following are suggested areas to check before attempting to service the microprocessor CPU and associated circuitry. These checks should be made before looking at the CPU and memory.

1. Supply voltage is correct.
2. Wiring harnesses, connectors, and solder joints are in good condition.
3. Appearance of physical damage, such as burned or broken components, overly hot components, or evidence of water damage.
4. Shorted or open diodes and transistors, especially driver transistors.

5. Voltage regulators working properly.
6. Excessive current draw in some or all the circuitry.
7. Correct input signals to unit.
8. Crystal oscillator operating and at proper frequency.
9. Reset circuitry working properly.

6.5 Circuit Boards

The following is a general description of the 3710 controller's electronic circuitry. While reading this description, refer to Figures 6-5 and 6-6.

The 3710 controller is a microprocessor-based device which executes a program stored in ROM. The program (software) is a series of instructions that tell the microprocessor what to do in order to accomplish the various functions which the sampler must perform. The software is discussed only as is necessary to describe the operation of the circuitry (hardware). The hardware is discussed below.

A 12 VDC connector on the side of the control box is used to connect to an external 12 V source. A 3.75 Amp PTC device provides circuit protection.

The 3710 controller contains two printed circuit boards: the main board (Figure 6-5) and the pump control board (Figure 6-6). The display module (attached to the main circuit board) also contains a small circuit board. This module is purchased assembled and does not contain any user-serviceable parts. Unless it is being replaced, the display module should not be disturbed.

6.5.1 Main Board

Power is supplied to the circuitry through P4 – pin 1 is ground and pin 2 is 12 V. A 5 V switching regulator (IC U11) is used to obtain a 5 V rail from the 12 V supply. All of the ICs used in the 3710 controller get their operating power from the 5 V rail. IC U11 is also used as a low voltage detector – it constantly monitors the 12 V supply. IC U17, a voltage converter, provides a -5 V supply which is needed for some components.

IC U8 is the microprocessor, IC U5 is the ROM, and IC U7 is the RAM. These three ICs make up the "brains" of the 3710 controller. The microprocessor executes the program stored in ROM. While executing, information (program settings, sample data, etc.) is retrieved from and stored in RAM. A 4.608 MHz crystal oscillator (Y1) sets the microprocessor's execution speed.

The 3710 controller keeps track of time with a real time clock (IC U3). Both the RAM and IC U3 are battery-backed with a lithium battery (B1). IC U1 is a switch which selects between battery and system power.

Three devices allow the microprocessor to communicate with the outside world: the 2 line, 20 characters per line LCD, IC U9, and IC U18. The LCD allows for communication with the user and is connected through P3. IC U13, transistor Q5, thermistor R20, and other components provide the LCD with a temperature compensated driver voltage. By providing temperature compensation, the display quality is optimized over a wide temperature

range. IC U9 and IC U18 are I/O devices which allow the microprocessor to: read the keypad, sound the beeper, count pump counts, and so on.

A 23 position keypad, connected at P5, is used to direct the microprocessor through the program. Many discrete components along with IC U9 are used to decode pressed keys. All user-originated instructions to the 3710 controller enter the system through the keypad.

The 3710 controller is supplied with a liquid detection system that gives it the ability to accurately deliver specified sample volumes. The liquid detection system consists of a piezoelectric sensor and filtering circuitry.

The sensor, mounted on the exterior of the control box, produces a signal proportional to an induced strain on the pump tubing. This signal is routed through P8 to IC U15 and its associated circuitry where it is massaged into a YES or NO indication of liquid presence. IC U15, containing a switched capacitor low pass filter and two Op Amps, is the main circuit component of the detection system.

An RS-232 serial communications port is connected to the system at P9. This port is used to output sampler status, program settings, and sampling results to a printer or an interrogator. IC U21, IC U19, and a handful of discrete components are used to transmit serial information, receive serial information, and sense the presence of the externally connected device.

6.5.2 Pump Control Board

The pump control board is an integral part of the pump assembly and serves two functions: control the pump motor and sense pump revolutions.

The pump motor control consists of a 2-pole double-throw relay (K201) and transistor switches (Q201, Q202 and Q203). The relay is used to change the pumping direction and will run the pump in the reverse direction when in the rest state. Each time the pump runs, the microprocessor sends the pumping direction signal through pin 1 of P7, waits for the relay to change state, then starts the pump by sending a high signal through pin 3 of P7. Waiting for the relay to change state before applying power prevents arcing at the relay contacts.

A key element of the pump revolution count sensor is the LED-phototransistor device (IC201). Whenever the pump is running, power is supplied to IC201. A rotating disk positioned between the LED and phototransistor periodically interrupts the transmitted signal. These interruptions create pulses which are sent back to the main board at pin 8 of P7 to be counted. The microprocessor uses these counts to determine the pumped volume.

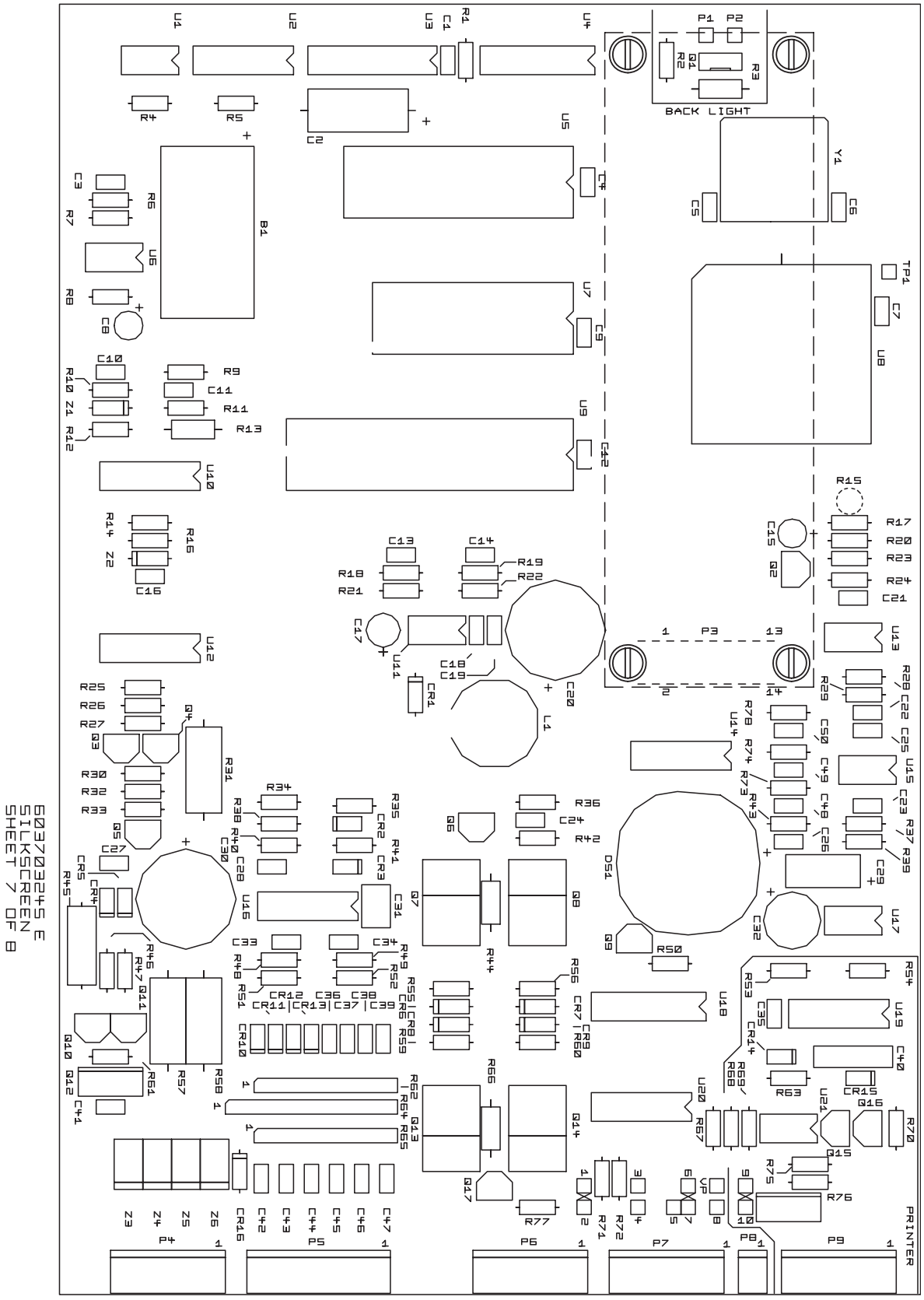


Figure 6-5 Main Circuit Board Component Layout

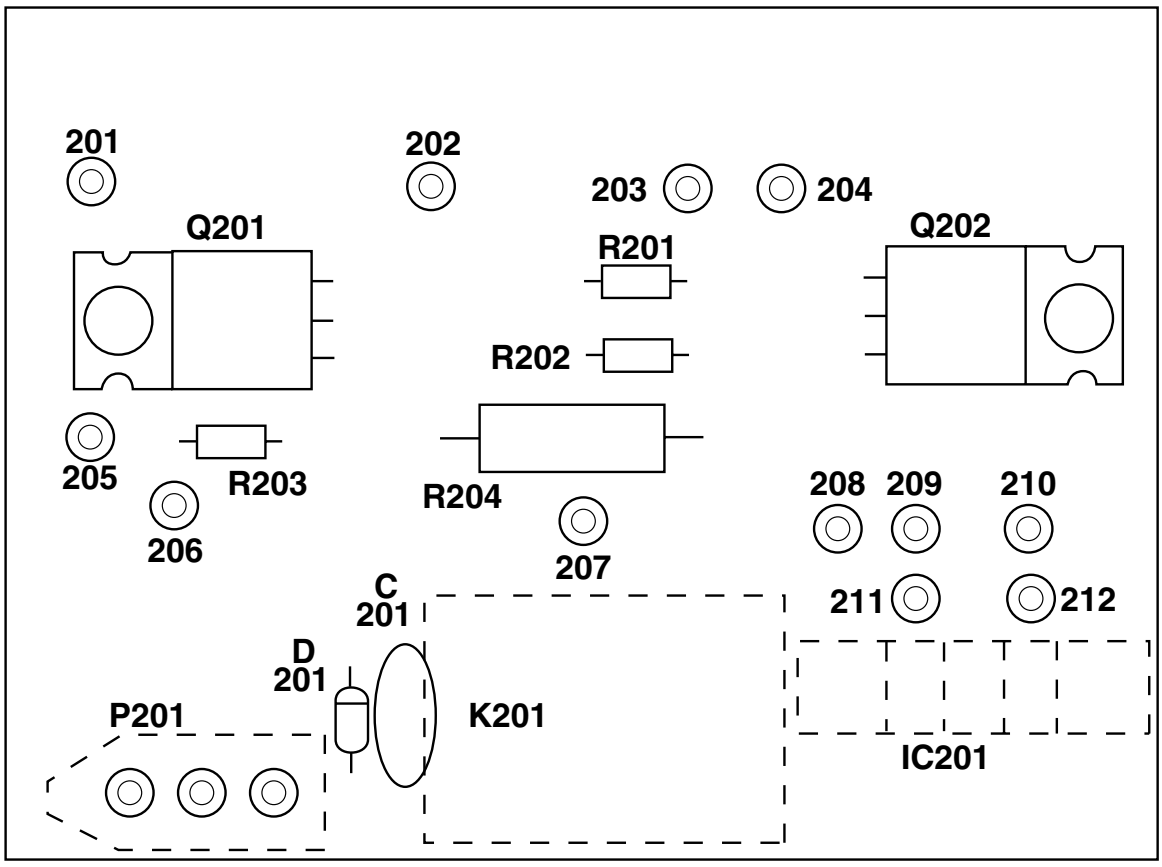


Figure 6-6 Optical Counter PCB Component Layout

6.6 Sample Event Cycle and Delivery of Sample Volumes

The sequence of steps in a typical sample event is described below. Should you suspect a malfunction in the delivery of the sample volumes, this information will assist you in determining the point at which the problem occurs.

1. A sample event is initiated.
2. The pump rotates in the reverse direction to air purge the suction line inlet of any accumulated debris.
3. The pump direction changes, pumping in the forward direction to fill the suction line.
4. After the suction line has been filled to the pump inlet, the sample volume measuring portion of the sampling cycle begins. The pump continues to rotate in the forward direction until the programmed sample volume has been delivered.
5. The pump direction again changes, pumping in the reverse direction to air purge the suction line to avoid cross-contamination of samples. The pump then shuts off.
6. The sampler waits until another sample event is initiated and the cycle begins again at step 1.

6.6.1 Peristaltic Pump

The following is a brief description of the method by which the sample volume is determined. The 3710 Sampler uses a peristaltic pump to transport the sample from the source to the sample bottle. When compared with other suction lift sample gathering methods, a peristaltic pump has numerous advantages: simplicity, reliability, no metering chamber required, easily cleaned, etc.

6.6.2 Volumetric Determination

The 3710 Sampler determines the volumetric delivery of its peristaltic pump by electronically counting revolutions of the pump rotor. Each revolution of the pump rotor corresponds to a fixed number of "pump counts" and a certain volume of sample liquid. However, the volume of liquid delivered by one revolution of the pump rotor changes with the suction head and the type of suction line. At each sample event, the liquid detection system automatically compensates for changes in suction head and adjusts the volume delivered for each revolution of the pump. Thus, for a given type of suction line, each revolution of the pump rotor results in the delivery of a known amount of sample volume.

6.6.3 Sample Delivery

The sample pumping portion of a sample event consists of three parts: suction line fill, liquid detection, and sample volume delivery. The sampler counts the number of pump revolutions as the suction line fills. At liquid detection, the controller uses that count to determine the proper number of pump revolutions required to deliver the programmed sample volume. It is important to note that the volume delivered by a peristaltic pump can be influenced by a number of factors other than those discussed above. Thus, even with the sophistication of the sample volume measuring functions of the sampler, the volume of sample deposited in the sample bottle may vary from the programmed value. The repeatability of a sample volume from sample to sample (which normally is the most important consideration) will typically be within the ± 10 ml specification stated in Table 1-1, on page 1-8.

A list of common replacement parts for use with the 3710 Sampler can be found in Appendix A. When ordering a replacement part, be sure to include the Teledyne Isco assembly or part number, a complete description, and the serial number of the sampler on which the part is going to be used.

A list of options and accessory parts described throughout this manual can be found in Appendix B. When ordering an option or accessory, include the part description and the Teledyne Isco part number.

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Appendix A Replacement Parts Lists

The following appendix contains illustrated replacement parts listings, including part descriptions and order numbers.

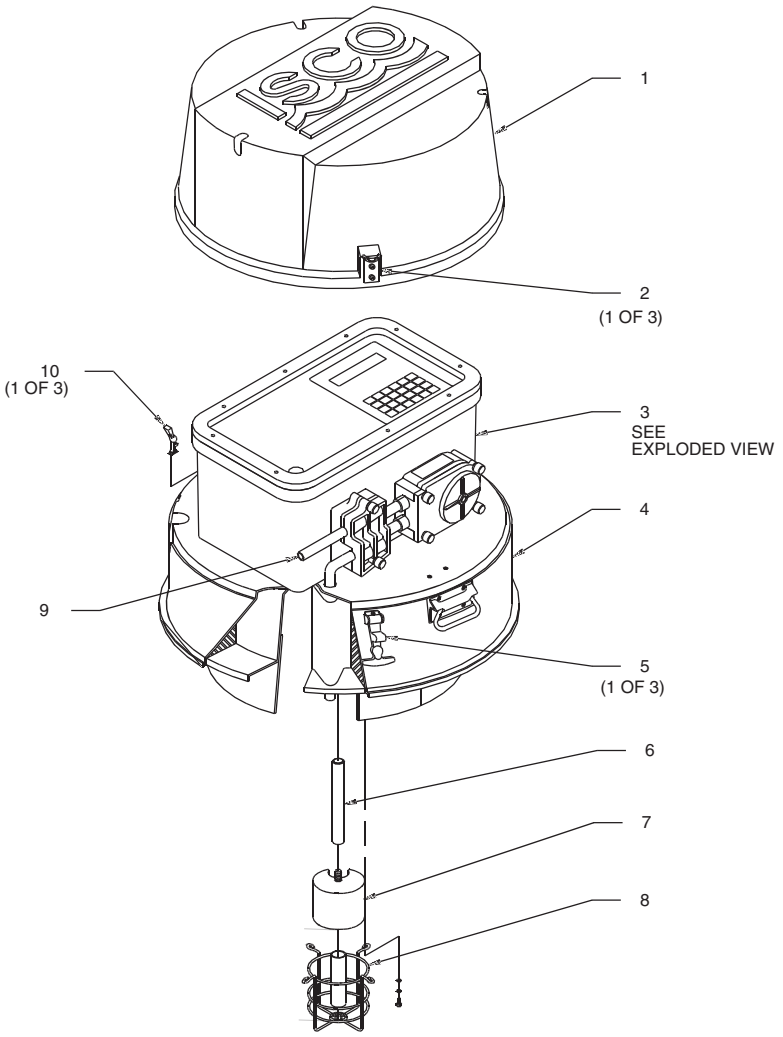
Replacement parts can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco, Inc.
Customer Service Department
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: (800) 228-4373
(402) 464-0231
FAX: (402) 465-3022

E-mail: IscoCSR@teledyne.com

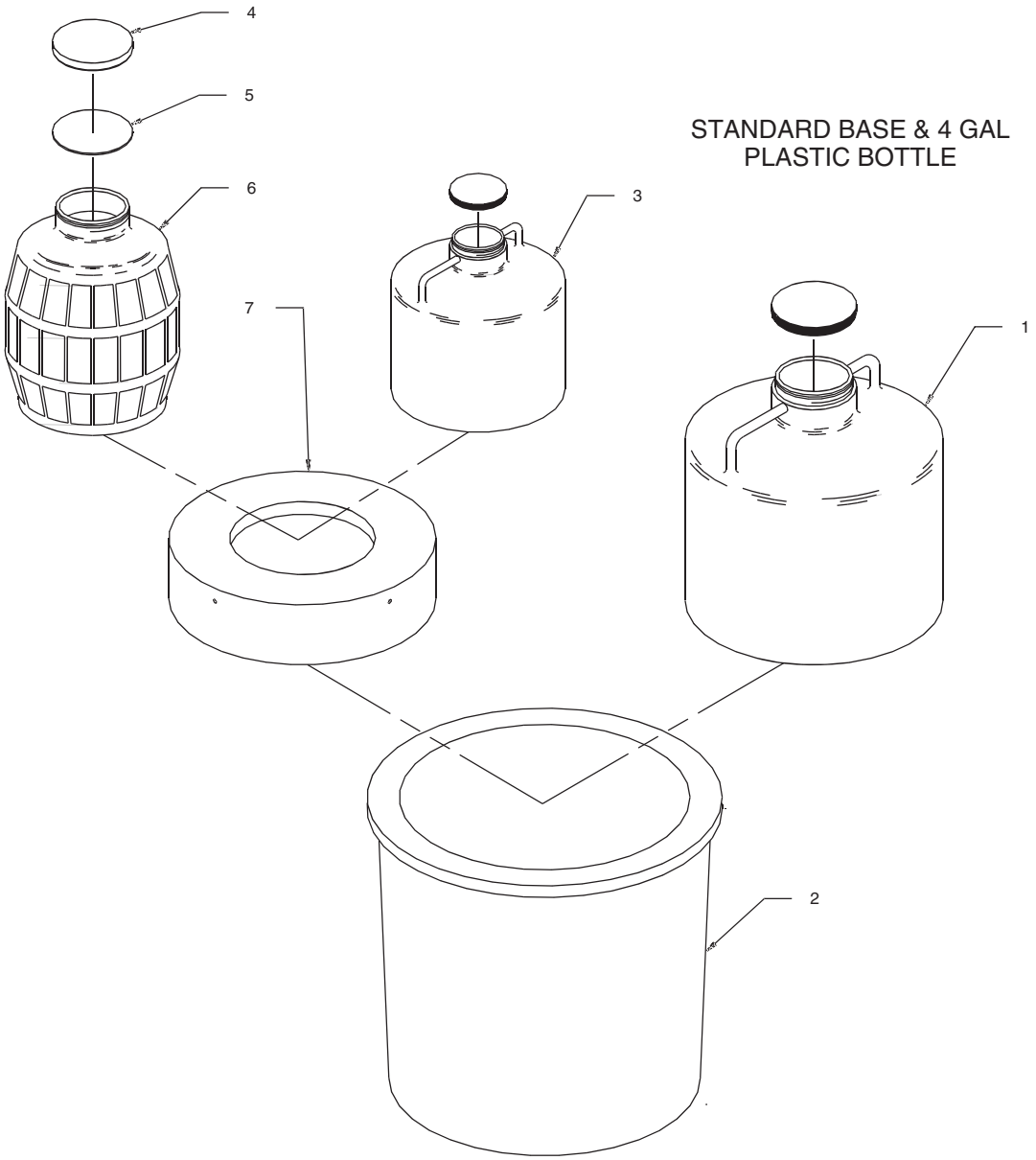
SAMPLER ASSEMBLY



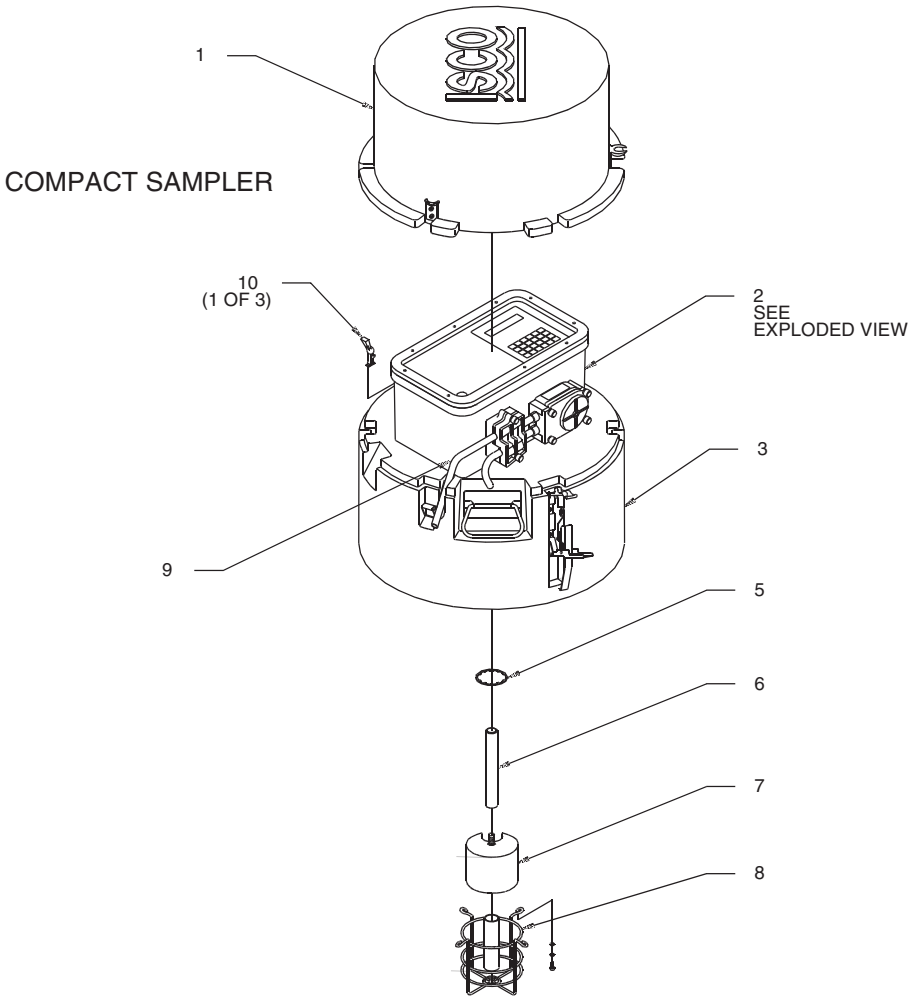
ITEM	INVENTORY NO.	DESCRIPTION
1	603704029	TOP COVER ASSY
2	601393142	DRAW CATCH KEEPER MOD
3	603714001	3710 SAMPLER CONTROLLER
4	603714008	CENTER SECTION ASSY
5	109060101	DRAW CATCH - LARGE
6	602714020	FLOAT SHAFT ASSY
7	602713003	FLOAT
8	601484021	FLOAT HOUSING ASSY
9	603714009	PUMP TUBING ASSY, 36"
10	109060503	DRAW LATCH ASSY - SMALL

STANDARD BASE & 2.5 GAL
GLASS OR PLASTIC BOTTLE

STANDARD BASE & 4 GAL
PLASTIC BOTTLE



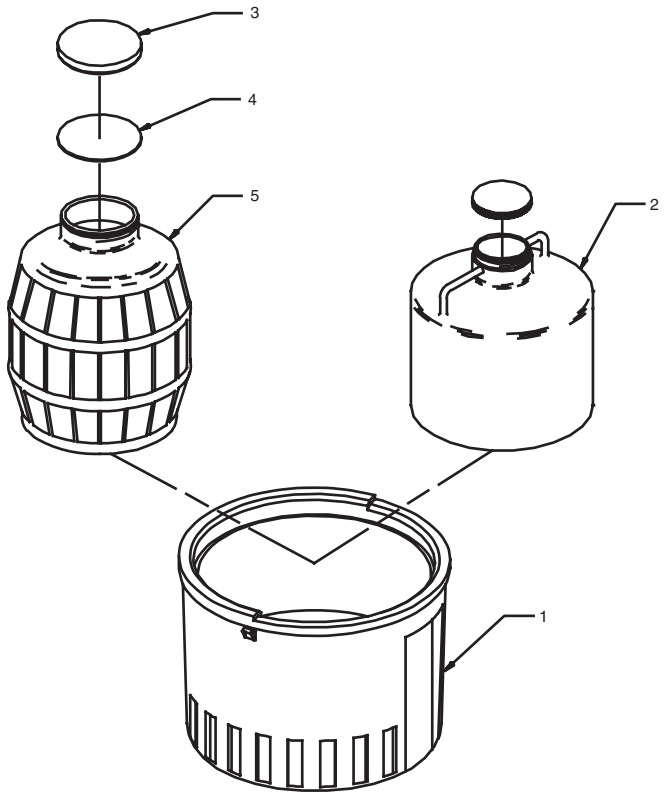
ITEM	INVENTORY NO.	DESCRIPTION
1	299001305	BTL NALGENE 4 GAL W/CAP
2	603714012	SAMPLER BASE ASSY
3	299001304	BTL NALGENE 2-1/2 GAL W/CAP
4	291000001	CAP POLYPRO LNRLS 120MM
5	299012000	LNR TEF 120MM X .020" THK
6	291000000	BTL GLS 2-1/2 GAL W/CAP BALE
7	603713013	LOCATING DECK, 2-1/2 GAL BTL (FOR 2.5 GAL SAMPLING ONLY)



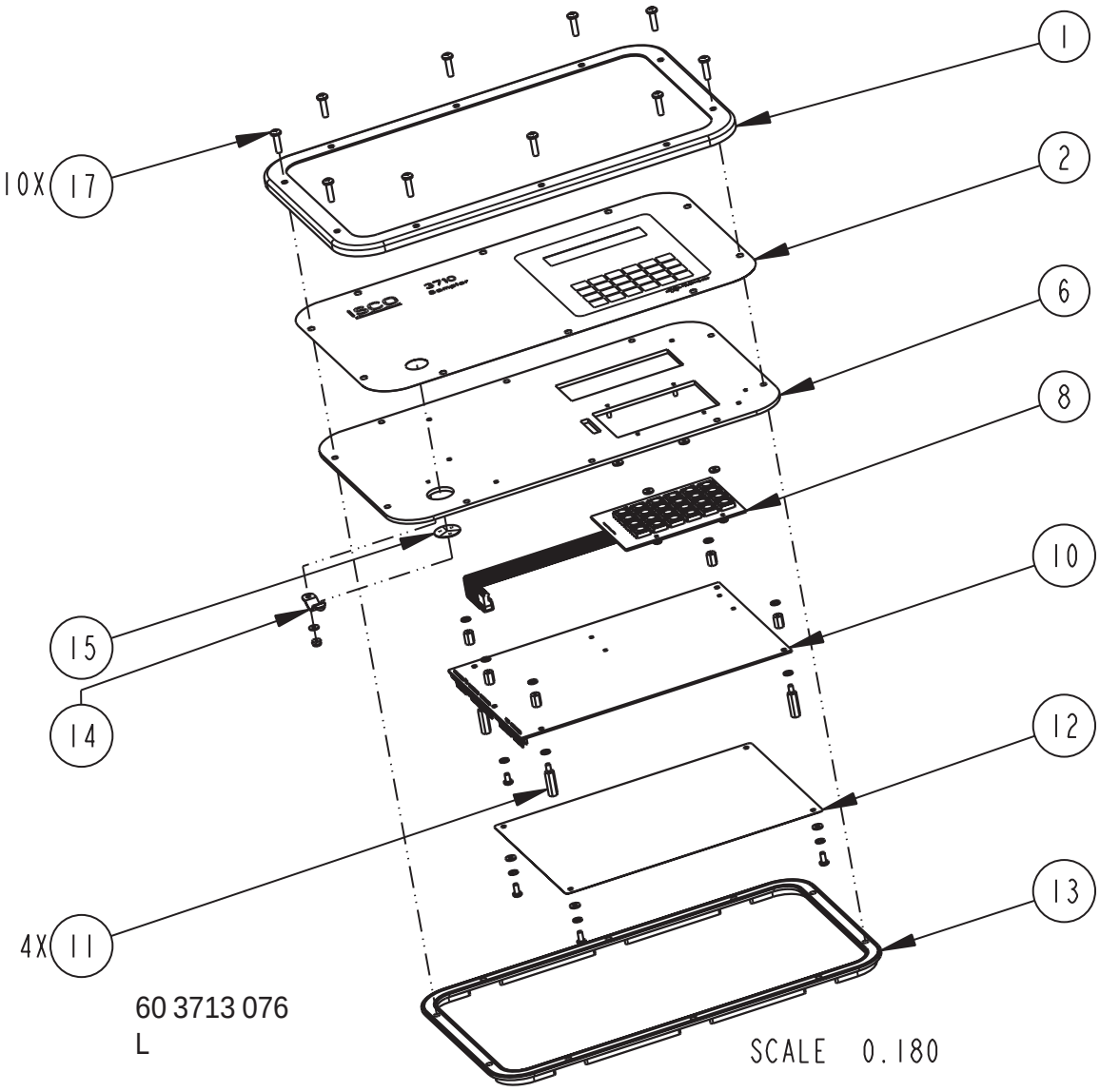
ITEM	INVENTORY NO.	DESCRIPTION
1	603704168	TOP COVER ASSY 3700C
2	603714001	3710 SAMPLER CONTROLLER
3	603704170	CENTER SECTION ASSY, 3700C
4	603713068	GUIDE FLOAT SHAFT (NOT SHOWN)
5	209000032	RTNG RING SST 1SFT 1.25OD
6	603714037	FLOAT SHAFT ASSY 3710C
7	602713003	FLOAT
8	602704052	FLOAT HOUSING ASSY
9	603714038	PUMP TUBING ASSY 33-1/2" 3710C
10	109060503	DRAW LATCH ASSY - SMALL
11*	609004244	CMPCT LATCH REPLACEMENT KIT (TO UPDATE OLD STYLE LATCHES)

*NOT SHOWN

COMPACT BASE & 2.5 GAL
GLASS OR PLASTIC BOTTLE



ITEM	INVENTORY NO.	DESCRIPTION
1	603704129	BASE ASSY 3700C
2	299001304	BTL NALGENE 2-1/2 GAL W/CAP
3	291000001	CAP POLYPRO LNRLS 120MM
4	299012000	LNR TEF 120MM X .020" THK
5	291000000	BTL GLS 2-1/2 GAL W/CAP BALE


1
2
6
8
10
12
13
10X 17
15
14
4X 11
60 3713 076
L
SCALE 0.180

603713076

REPLACEMENT PARTS LIST

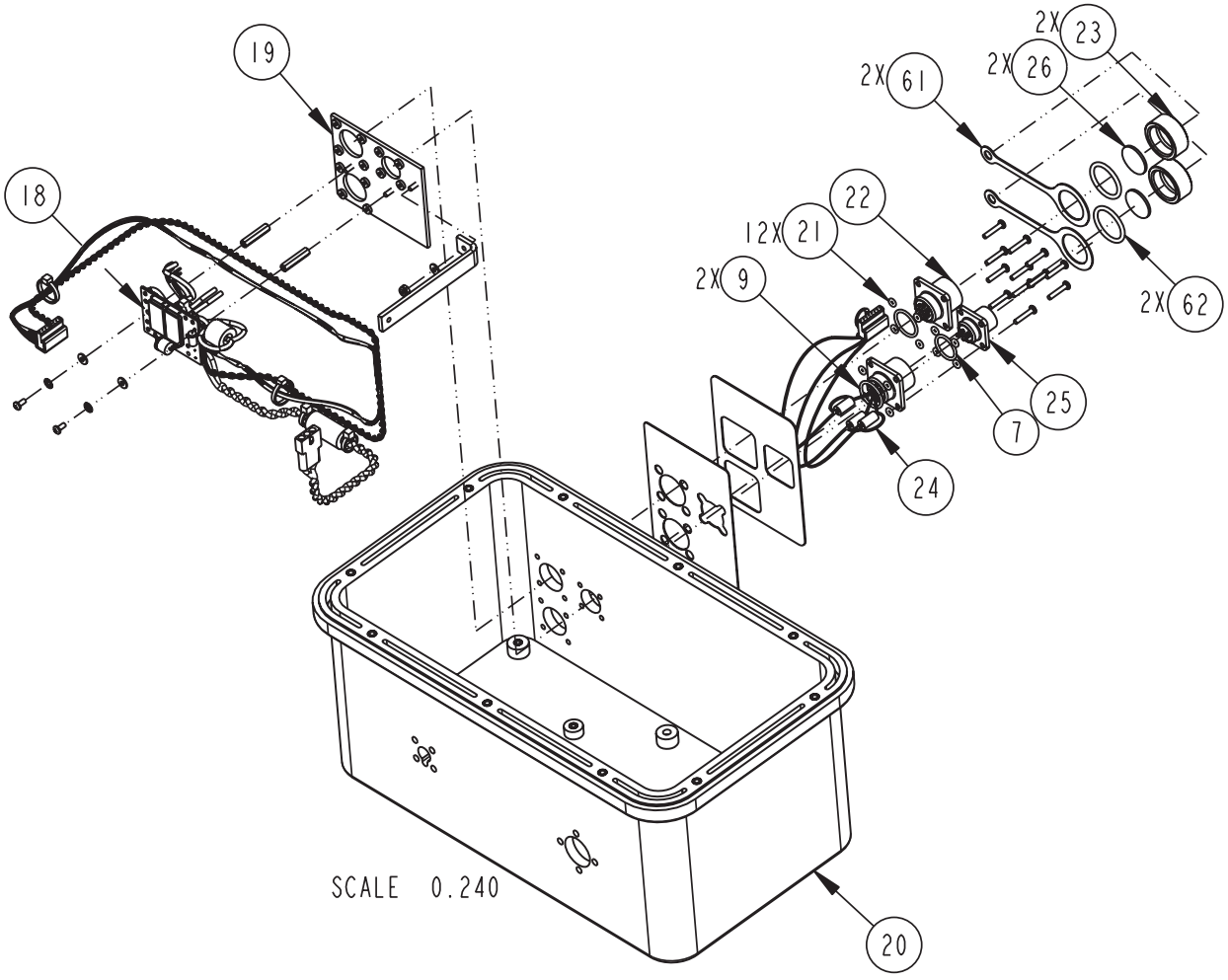
SHEET: 2 OF 7

TELEDYNE ISCO, INC.

REV: L | DATE: 06010

ITEM NO.	PART NUMBER	DESCRIPTION
1	693703282	RING TRIM
2	603713004	LABEL CONTROL PANEL
6	603708003	CONTROL PANEL STUD ASSEMBLY
8	693704003	WIRING ASSEMBLY KEYPAD
10	693704180	CIRCUIT BOARD ASSY, 3700 CPU
11	603703028	STANDOFF 1/4 HEX, SST 6-32M/F X .781
12	693703008	ELECTROSTATIC DISCHARGE SHIELD
13	602703010	CONTROL BOX GASKET
14	209902138	TENSION CLIP 3/8 DIA.
15	490001300	HUMIDITY INDICATOR CARD
17	231514510	SCREW CAP SST 8-32 X 5/8
7	202300016	'O' RING .614 ID, .070 CROSS SECTION
9	202307017	'O' RING .676 ID, .070 CROSS SECTION

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.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18
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12X
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SCALE 0.240
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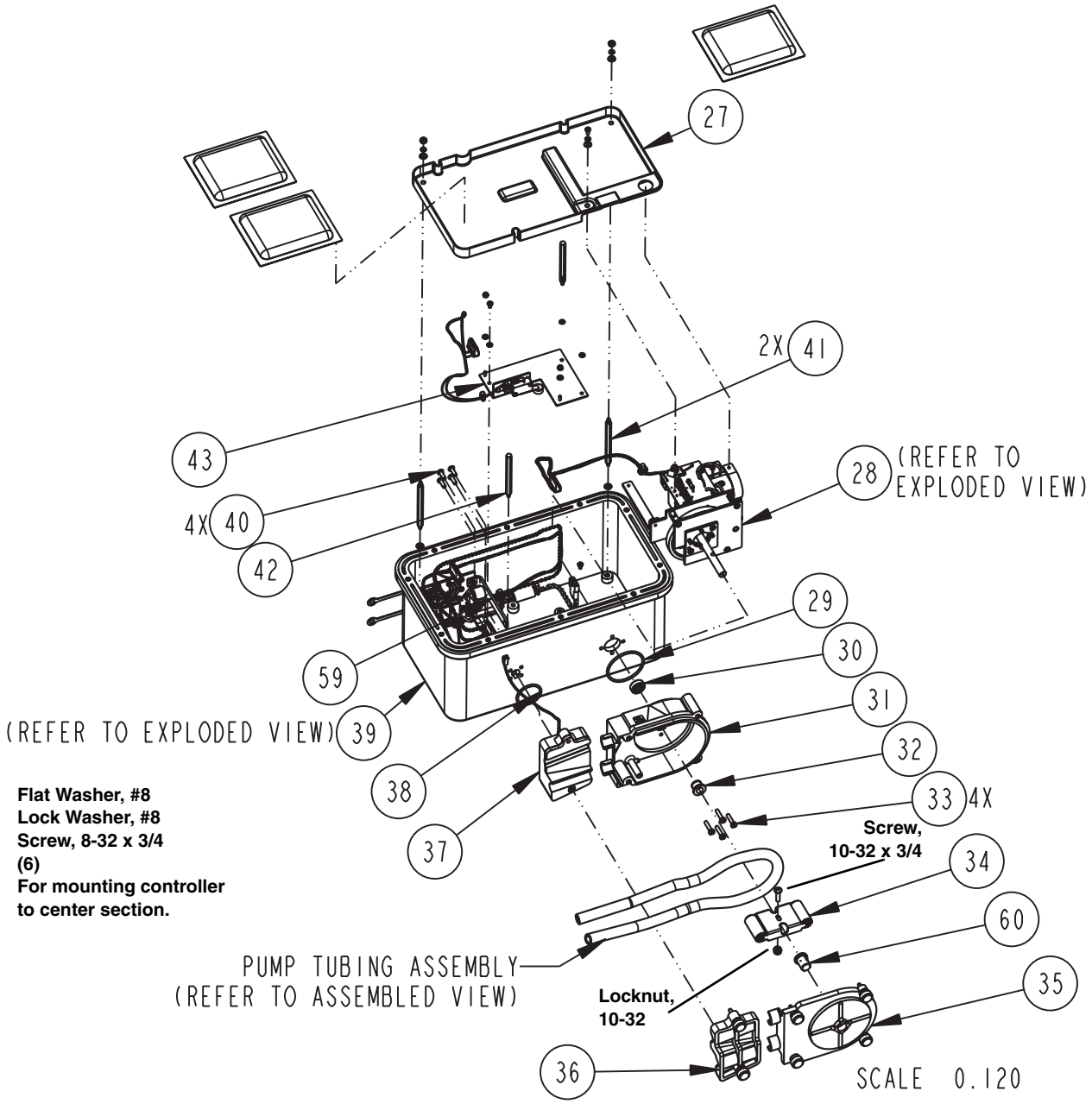


Flat Washer, #8
Lock Washer, #8
Screw, 8-32 x 3/4
(6)
For mounting controller to center section.

603713076

REPLACEMENT PARTS LIST

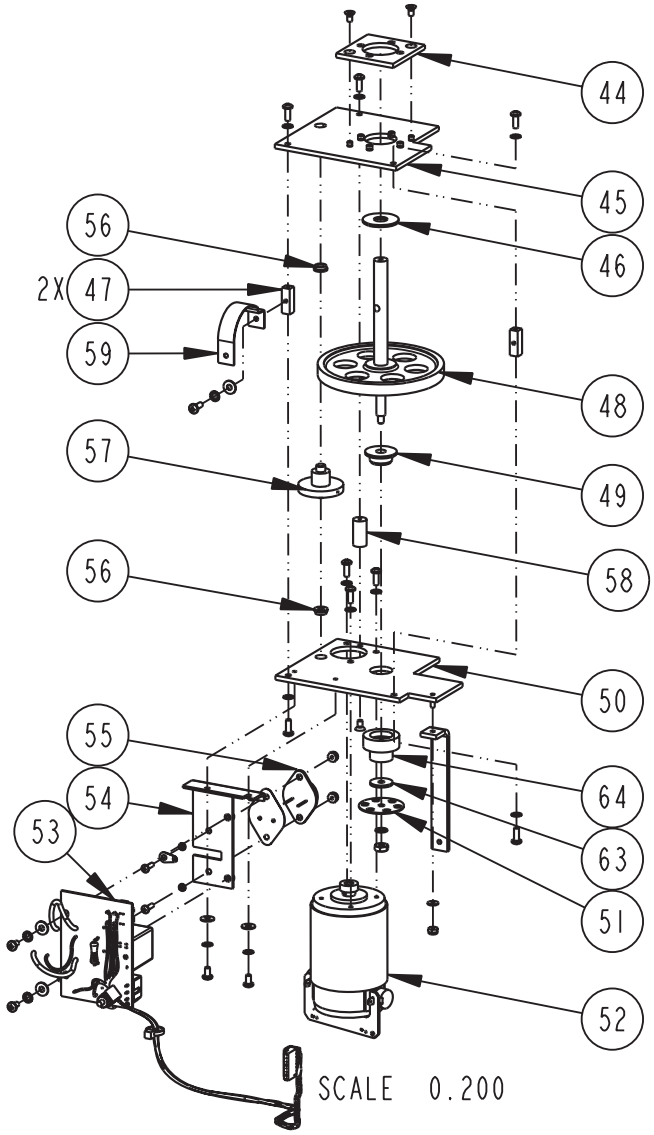
SHEET: 5 OF 7

TELEDYNE ISCO, INC.

REV: L | DATE: 06010

ITEM NO.	PART NUMBER	DESCRIPTION
18	603704151	CIRCUIT BOARD ASSEMBLY, POWER SUPPLY CONNECTIONS
19	603704149	BACK PLATE STUD ASSEMBLY, CE
20	603714026	CONTROL BOX MODIFICATION ASSEMBLY
21	202907010	O RING, .100 ID, .070 CROSS SECTION
22	140100600	PLUG, PANEL MOUNT, 6 PIN
23	603113024	CONNECTOR PROTECTOR CAP, MEDIUM
24	603704091	PRINTER CONNECTOR ASSEMBLY
25	140100201	PLUG, PANEL MOUNT, 2 PIN
26	603113032	CONNECTOR CAP GASKET, MEDIUM
27	603703252	DESICCANT TRAY, CE
28	603704154	PUMP GEAR CASE ASSEMBLY, CE
29	202100135	O RING, 1.925 ID, .103 CROSS SECTION,
30	202999903	LIP SEAL, .375 ID X .750 OD
31	603704019	PUMP HOUSING ASSEMBLY, INSIDE
32	603703012	PUMP HOUSING BUSHING
33	231914512	SCREW, MACHINE, 8-32 X 3/4, PAN HEAD, SLOTTED, SST, SELF SEALING, O RING
34	602704019	PUMP ROTOR ASSEMBLY
35	603704017	PUMP HOUSING ASSEMBLY, OUTSIDE
36	603704021	DETECTOR LID ASSEMBLY
37	603704022	DETECTOR BASE ASSEMBLY
38	202401237	O RING, 1.237 ID, .103 CROSS SECTION,
39	603714047	CONTROL BOX SUB-ASSEMBLY, CE
40	231019508	SCREW, MACHINE, 8-32 X 1/2, PAN HEAD, PHILLIPS, SST, SELF SEALING, O-RING
41	602703170	STANDOFF, 6-32 X .25 HEX X 3.00 LONG, MALE, STAINLESS STEEL
42	603714017	SHORT STANDOFF ASSEMBLY
43	603714045	SHUTOFF MICROSWITCH ASSEMBLY, CE
59	603703256	INTERCONNECT STRAP, 5.5"
60	603703278	PUMP HOUSING BUSHING

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.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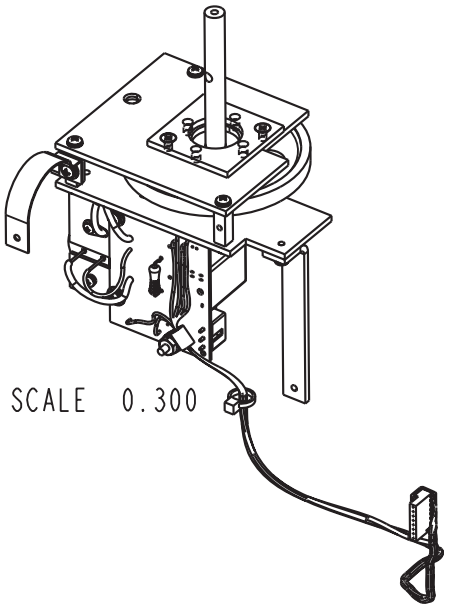
SCALE 0.300

603713076

REPLACEMENT PARTS LIST

SHEET: 7 OF 7

TELEDYNE ISCO, INC.

REV: L | DATE: 06010

ITEM NO.	PART NUMBER	DESCRIPTION
44	602703037	PUMP SHAFT SPACER PLATE
45	602703050	PUMP PLATE
46	602703058	SPACER, .380 ID X 1.00 OD X .060 LONG, DELRIN
47	602703096	STANDOFF, 6-32 X .25 SQUARE X .75 LONG, AL
48	602704010	PUMP SHAFT ASSEMBLY
49	602703076	FLANGED BEARING, .275 ID X .625 OD X .31 LONG
50	603704160	MOTOR PLATE ASSEMBLY, CE
51	602703063	PUMP SHAFT OPTICAL DISK
52	603704172	PUMP MOTOR WITH FILTER ASSEMBLY
53	602704039	CIRCUIT BOARD ASSEMBLY, COUNTER
54	602704048	MOUNTING PLATE ASSEMBLY, OPTICAL COUNTER
55	402025801	TRANSISTOR, 2N5881/2N5882
56	201311200	BEARING, BRONZE, FLANGED, .1891D, .314 OD, 1/8 LONG W/ 3/64 THICK .375 FLANGE
57	602704008	PUMP GEAR SHAFT ASSEMBLY
58	237115000	STANDOFF, 3/16 ROUND, 3/4 LONG, 6-32 FEMALE-FEMALE, AL, CLEAR IRIDITE
59	603703256	INTERCONNECT STRAP, 5.5"
61	609003250	STRAP, DRAIN CAP
62	202400114	'O' RING .612 ID, .103 CROSS SECTION
63	233010804	WSHR, FLAT .171 ID X .625 OD X .060
64	603703291	SPACER, PUMP GEAR CASE ASSEMBLY

NOTE: 1. For current prices and quotations on parts, contact Isco Service Department.
2. This list is subject to change without notice.

3710 Portable Samplers

Appendix B Accessories

The following appendix contains the most commonly ordered accessories for the 3710 sampler, including part descriptions and order numbers. For additional accessories, contact Teledyne Isco Customer Service or your local sales representative.

Accessories can be purchased by contacting Teledyne Isco's Customer Service Department.

Teledyne Isco, Inc.
Customer Service Department
P.O. Box 82531
Lincoln, NE 68501 USA

Phone: (800) 228-4373
(402) 464-0231
FAX: (402) 465-3022

E-mail: IscoCSR@teledyne.com

B.1 General Accessories

3700/3710 Sampler Accessory Kit (includes lead-acid battery, 120 VAC wall charger, 3/8" ID x 25' vinyl suction line, and a weighted polypropylene bodied strainer)	68-3710-014
Extra Silastic pump tubing, 36" length – Standard sampler	60-3714-009
Extra Silastic pump tubing, 33 1/2" length – Compact sampler	60-3714-038
Snap-on suspension harness	60-1394-014
Sampler Locking Assembly – Standard sampler	68-3700-056
Sampler Locking Assembly – Compact sampler	68-6700-111
Model 3710 Sampler controller with pump tubing and instruction manual	68-3710-004
Extra Pocket Guide, Model 3710	60-3713-036
Extra Silastic pump tubing, bulk 10' length.	68-6700-046
Extra Silastic pump tubing, bulk 50' length.	68-6700-047
Plastic graduated cylinder, 1000 ml, for sample volume calibration	299-0020-00

B.2 Bottles and Accessories

2.5 gallon polyethylene container with cap	299-0013-04
2.5 gallon glass container with cap and PTFE liner	68-2700-005
4 gallon polyethylene container with cap (Standard sampler only)	299-0013-05
Locating insert (required for standard samplers using 2.5 gallon glass and plastic bottles)	60-3703-062

B.3 Suction Lines and Strainers

3/8" ID x 10' vinyl suction line with standard weighted polypropylene strainer 60-9004-378
3/8" ID x 25' vinyl suction line with standard weighted polypropylene strainer 60-9004-379
3/8" ID x 10' PTFE suction line with protective coating, without strainer 60-1683-146
3/8" ID x 25' PTFE suction line with protective coating, without strainer 60-2703-114
3/8" Standard Weighted Polypropylene Strainer 60-9004-367
1/4" Stainless steel low flow strainer only 69-2903-139
3/8" Stainless steel low flow strainer only 69-2903-138
3/8" Weighted strainer only, CPVC coated body 60-3704-066
1/4" ID vinyl tubing, bulk 100' 68-1680-055
1/4" ID vinyl tubing, bulk 500' 68-1680-056
1/4" ID vinyl tubing, bulk 1000' 68-1680-057
3/8" ID vinyl tubing, bulk 100' 68-1680-058
3/8" ID vinyl tubing, bulk 500' 68-1680-059
1/4" Vinyl tubing coupler 68-3700-006
3/8" Vinyl tubing coupler 68-3700-007
1/4" Stainless steel suction line coupler 69-4703-154
3/8" Stainless steel suction line coupler 69-4703-106
Extra Silastic pump tubing, bulk 10' length 68-6700-046
Extra Silastic pump tubing, bulk 50' length 68-6700-047

B.4 Power Sources

913 High Capacity Power Pack (120-volt) 60-1684-088
914 Battery-Backed Power Pack (120-volt) 60-3004-130
923 High Capacity Power Pack (240-volt) 60-1684-093
924 Battery-Backed Power Pack (240-volt) 60-3004-160
934 Nickel-Cadmium Battery 60-1684-040
946 Lead-Acid Battery 60-3004-106
948 45-Amp-Hour Battery 68-3000-948
Portable 12-volt DC, 6-Amp Battery Charger for 948 Battery 341-0118-12
961 Battery Charger (120-volt) 60-3004-059
Model 965 Five-Station Battery Charger, 120/240 V, with 120 V power cord 68-3000-965
Model 965 Five-Station Battery Charger, 120/240 V, with 240 V power cord 68-3000-966
Solar Panel Battery Charger, 5-watt 60-5314-478
Solar Panel Battery Charger, 40-watt 60-5314-347
Solar Panel Battery Charger, 90-watt 60-5314-399
5-watt Solar Panel Cable (25-foot Length) 60-3004-097
Solar Panel “Y” Cable 60-3004-098
Solar Panel Extension Cable (25-foot Length) 60-2544-028
Connect cable, for external 12 VDC power source; terminates in heavy duty battery clips . . 60-1394-023

B.5 Interfacing Equipment

1640 Liquid Level Actuator 60-1644-000
1640 Instruction Manual 60-1644-009
Connect cable, 25', Isco sampler to Isco flow meter 60-3004-107
Connector only, without cable, for use with non-Isco flow meters with an isolated contact closure proportional to flow 68-1680-060
Same as above, with 22' cable terminating in two wires 60-1394-077
2100 Series Sampler Interface Cable 60-2004-260
4-20 mA Sampler Input Interface (converts analog signal flow meter output as specified by user into pulses acceptable to Isco samplers) 60-3704-037
Flowlink Software with manual . . . . . call factory
Samplink Sampler Interrogation Software with manual 60-3774-013
Interrogator communications line kit - 9-pin (connects laptop computer with a 9-pin serial port to sampler). 60-2544-044
Interrogator communications line kit - 25-pin (connects laptop computer with 25-pin serial port to sampler) 60-2544-040
Master/Slave Interconnect Cable, 10' 60-3704-065
3710 Master/Slave to Flow Meter Cable (Connects two 3710 Samplers as a master and slave to a flow meter 60-3704-080

3710 Portable Samplers

Appendix C General Safety Procedures

In field installations of Teledyne Isco Samplers and associated equipment, the safety of the personnel involved should be the foremost consideration. The following sections provide safety procedures for working in and around manholes and sewers. the first section offers general safety advice. The second section deals with the special problem of hazardous gases found in sewers.

⚠ WARNING

The 3710 Sampler has not been approved for use in hazardous locations as defined by the National Electrical Code.

⚠ CAUTION

Before any sampler is installed, the proper safety precautions must be taken. The following discussions of safety procedures are only general guidelines. Each situation in which you install a flow meter varies. You must take into account the individual circumstances you are in. Additional safety considerations, other than those discussed here, may be required.

C.1 Practical Safety Precautions

The following procedures are those used by Black & Veatch, a respected consulting firm, and are published here by permission.

"Field personnel must keep safety uppermost in their minds at all times. When working above ground, rules of common sense and safety prevail. However, when entering manholes, strict safety procedures must be observed. Failure to do so could jeopardize not only your own life, but also the lives of other crew members.

"1. **Hazards.** There are many hazards connected with entering manholes. Some of the most common hazards are:

"**Adverse Atmosphere.** The manhole may contain flammable or poisonous gases or the atmosphere may be deficient in oxygen. Forced ventilation may be necessary.

"**Deteriorated Rungs.** Manhole steps may be corroded and not strong enough to support a man. It may be difficult to inspect the rungs because of poor lighting.

"**Traffic.** Whenever manholes are located in the traveled way, barricades and warning devices are essential to direct traffic away from an open manhole.

"**Falling Object.** Items placed near the manhole opening may fall and injure a worker in the manhole.

"**Sharp Edges.** Sharp edges of items in or near a manhole may cause cuts or bruises.

"**Lifting Injuries.** Unless proper tools are used to remove manhole covers, back injuries or injuries to hands or feet may result.

"2. **Planning.** Advance planning should include arrangements for test equipment, tools, ventilating equipment, protective clothing, traffic warning devices, ladders, safety harness, and adequate number of personnel. Hasty actions may result in serious injuries. Time spent in the manhole should be kept to a minimum.

"3. **Adverse Atmosphere.** [Refer to Table C-1, Hazardous Gases, at the end of this appendix.] Before workers enter a manhole, tests should be made for explosive atmosphere, presence of hydrogen sulfide, and oxygen deficiency. Combustible or toxic vapors may be heavier than air, so the tests on the atmosphere must be run at least 3/4 of the way down the manhole.

"Whenever adverse atmosphere is encountered, forced ventilation must be used to create safe conditions. After the ventilating equipment has been operated for a few minutes, the atmosphere in the manhole should be retested before anyone enters the manhole.

"When explosive conditions are encountered, the ventilating blower should be placed upwind to prevent igniting any gas that is emerging from the opening. When a gasoline engine blower is used, it must be located so that exhaust fumes cannot enter the manhole.

"If testing equipment is not available, the manhole should be assumed to contain an unsafe atmosphere and forced ventilation must be provided. It should never be assumed that a manhole is safe just because there is no odor or the manhole has been entered previously.

"4. **Entering Manholes.** Since the top of the manhole is usually flush with the surrounding surface, there may not be anything for the person who is entering the manhole to grab on to steady himself. Persons who are entering manholes should not be permitted to carry anything in their hands as they enter the manhole, to ensure that their hands will be free to hold on or grab if they slip. A good method for entering a manhole is to sit on the surface facing the manhole steps or ladder, with the feet in the hole and the arms straddling the opening for support. As the body slides forward and downward, the feet can engage a rung, and the back can rest against the opposite side of the opening. If there is any doubt about the soundness of the manhole steps, a portable ladder should be used.

"A person should never enter a manhole unless he is wearing personal safety equipment, including a safety harness and a hard hat. Two persons should be stationed at the surface continuously while anyone is working inside a manhole, to lift him out if he is overcome or injured. One man cannot lift an unconscious man out of a manhole. The persons stationed at the surface should

also function as guards to keep people and vehicles away from the manhole opening. To avoid a serious injury, a person should not be lifted out of a manhole by his arm unless it is a dire emergency.

"When more than one person must enter a manhole, the first person should reach the bottom and step off the ladder before the next one starts down. When two men climb at the same time, the upper one can cause the lower one to fall by slipping or stepping on his fingers.

"5. **Traffic Protection.** In addition to traffic cones, markers, warning signs, and barricades, a vehicle or a heavy piece of equipment should be placed between the working area and oncoming traffic. Flashing warning signals should be used to alert drivers and pedestrians. Orange safety vests should be worn by personnel stationed at the surface when the manhole is located in a vehicular traffic area.

"6. **Falling Object.** All loose items should be kept away from the manhole opening. This applies to hand tools as well as stones, gravel and other objects.

"7. **Removing the Covers.** Manhole covers should be removed with a properly designed hook. Use of a pick ax, screwdriver, or small pry bar may result in injury. A suitable tool can be made from 3/4-inch round or hex stock. Two inches of one end should be bent at a right angle and the other end should be formed into a D-handle wide enough to accommodate both hands. Even with this tool, care must be exercised to prevent the cover from being dropped on the toes. The 2-inch projection should be inserted into one of the holes in the cover, the handle grasped with both hands, and the cover lifted by straightening the legs which have been slightly bent at the knees.

"8. **Other Precautions.** Other precautions which should be taken when entering a manhole are:

- Wear a hard hat.
- Wear coveralls or removable outer garment that can be readily removed when the work is completed.
- Wear boots or nonsparking safety shoes.
- Wear rubberized or waterproof gloves.
- Wear a safety harness with a stout rope attached.
- Do not smoke.
- Avoid touching yourself above the collar until you have cleaned your hands.

"9. **Emergencies.** Every member of the crew should be instructed on procedures to be followed in cases of an emergency. It is the duty of each crew chief to have a list of emergency phone numbers, including the nearest hospital and ambulance service, police precinct, fire station, and rescue or general emergency number.

"10. **Field Equipment.** The following equipment will be available for use:

Blowers	Gloves	Traffic cones
Breathing apparatus	Hard Hats	Coveralls
Harnesses	First aid kits	Manhole irons
Emergency flashers	Pick axes	Flashlights
Rain slickers	Mirrors	Ropes
Gas detectors	Safety vests	Gas masks
Waders"		

C.2 Lethal Atmospheres in Sewers

The following is an article written by Dr. Richard D. Pomeroy, and published in the October 1980 issue of ***Deeds & Data*** of the WPCF. Dr. Pomeroy is particularly well known for his studies, over a period of nearly 50 years, in the field of the control of hydrogen sulfide and other odors in sewers and treatment plants. He has personally worked in a great many functioning sewers. In the earlier years he did so, he admits, with little knowledge of the grave hazards to which he exposed himself.

"It is gratifying that the subject of hazards to people working in sewers is receiving much more attention than in past years, and good safety procedures are prescribed in various publications on this subject. It is essential that people know and use correct procedures.

"It is less important to know just what the hazardous components of sewer atmospheres are, as safety precautions should in general be broadly applicable, but there should be a reasonable understanding of this subject. It is disturbing to see statements in print that do not reflect true conditions.

"One of the most common errors is the assumption that people have died from a lack of oxygen. The human body is able to function very well with substantially reduced oxygen concentrations. No one worries about going to Santa Fe, New Mexico, (elev. 2,100 meters), where the partial pressure of oxygen is equal to 16.2% (a normal atmosphere is about 21%) oxygen. When first going there, a person may experience a little 'shortness of breath' following exercise. People in good health are not afraid to drive over the high passes in the Rocky Mountains. At Loveland Pass, oxygen pressure is 13.2% of a normal atmosphere. At the top of Mt. Whitney, oxygen is equal to 12.2%t. Many hikers go there, and to higher peaks as well. After adequate acclimation, they may climb to the top of Mt. Everest, where oxygen is equal to only 6.7%.

"The lowest oxygen concentrations that I have observed in a sewer atmosphere was 13 percent. It was in a sealed chamber, near sea level, upstream from an inverted siphon on a metropolitan trunk. A man would be foolish to enter the chamber. Without ventilation, he might die, but not from lack of oxygen.

"It seems unlikely that anyone has ever died in a sewer from suffocation, that is, a lack of oxygen. Deaths have often been attributed to 'asphyxiation.' This is a word which, according to the dictionary, is used to mean death from an atmosphere that does not support life. The word has sometimes been misinterpreted as meaning suffocation, which is only one kind of asphyxiation.

"In nearly all cases of death in sewers, the real killer is hydrogen sulfide. It is important that this fact be recognized. Many cities diligently test for explosive gases, which is very important, and they may measure the oxygen concentration which usually is unimportant, but they rarely measure H_2S. Death has occurred where it is unlikely that there was any measurable reduction in the oxygen concentration. Waste water containing 2 mg per liter of dissolved sulfide, and at a pH of 7.0, can produce, in a chamber with high turbulence, a concentration of 300 PPM H_2S, in the air. This is considered to be a lethal concentration. Many people have died from H_2S, not only in sewers and industries, but also from swamps and from hot springs. In one resort area, at least five persons died from H_2S poisoning before the people were ready to admit that H_2S is not a therapeutic agent. Hardly a year passes in the U.S. without a sewer fatality from H_2S as well as deaths elsewhere in the world.

"The presence of H_2S in a sewer atmosphere is easily determined. A bellows-and-ampoule type of tester is very satisfactory for the purpose, even though it is only crudely quantitative. When using a tester of this type, do not bring the air to the ampoule by way of a tube, as this may change the H_2S concentration. Hang the ampoule in the air to be tested, with a suction tube to the bulb or bellows.

"Lead acetate paper is very useful as a qualitative indicator. It cannot be used to estimate the amount of sulfide, but it will quickly turn black in an atmosphere containing only a tenth of a lethal concentration.

"Electrodes or other similar electrical indicating devices for H_2S in air have been marketed. Some of them are known to be unreliable, and we know of none that have proved dependable. Do not use one unless you check it at frequent intervals against air containing known H_2S concentrations. A supposed safety device that is unreliable is worse than none at all.

"Remember that the nose fails, too, when it comes to sensing dangerous concentrations of H_2S.

"Various other toxic gases have been mentioned in some publications. It is unlikely that any person has been asphyxiated in a sewer by any of those other gases, except possibly chlorine. The vapor of gasoline and other hydrocarbons is sometimes present in amounts that could cause discomfort and illness, but under that condition, the explosion hazard would be far more serious. The explosimeter tests, as well as the sense of smell, would warn of the danger. Pipelines in chemical plants might contain any

number of harmful vapors. They, too, are sensed by smell and explosimeter tests if they get into the public sewer. Such occurrences are rare.

"The attempt to instill a sense of urgency about real hazards is diluted if a man is told to give attention to a long list of things that in fact are irrelevant.

"Be very careful to avoid high H_2S concentrations, flammable atmospheres, and hazards of physical injuries. Remember that much H_2S may be released by the stirring up of sludge in the bottom of a structure. Obey your senses in respect to irritating gases, such as chlorine (unconsciousness comes suddenly from breathing too much). Be cautious about strange odors. Do not determine percent oxygen in the air. There is a danger that the result will influence a man's thinking about the seriousness of the real hazards. Most important, use ample ventilation, and do not enter a potentially hazardous structure except in a good safety harness with two men at the top who can lift you out."

C.3 Hazardous Gases

The following table contains information on the properties of hazardous gases.

Table C-1 Hazardous Gases

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air =1	Physiological Effect	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Ammonia	NH_3	Irritant and poisonous. Colorless with characteristic odor.	0.60	Causes throat and eye irritation at 0.05%, coughing at 0.17%. Short exposure at 0.5% to 1% fatal.	300 to 500	85	16 25	Near top. Concentrates in closed upper spaces	Sewers, chemical feed rooms.	Detectable odor at low concentrations
Benzene	C_6H_6	Irritant, colorless anesthetic	2.77	Slight symptoms after several hours exposure at 0.16% to 0.32%. 2% rapidly fatal.	3,000 to 5,000	25	1.3 7.1	At bottom.	Industrial wastes, varnish, solvents.	Combustible gas indicator
Carbon Bisulfide	CS_2	Nearly odorless when pure, colorless, anesthetic. Poisonous.	2.64	Very poisonous, irritating, vomiting, convulsions, psychic disturbance.	—	15	1.3 44.0	At bottom	An insecticide	Combustible gas indicator

Table C-1 Hazardous Gases (Continued)

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air =1	Physiological Effect	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Carbon Dioxide	CO_2	Asphyxiant, Colorless, odorless. When breathed in large quantities, may cause acid taste. Non-flammable. Not generally present in dangerous amounts unless an oxygen deficiency exists.	1.53	Cannot be endured at 10% more than a few minutes, even if subject is at rest and oxygen content is normal. Acts on respiratory nerves.	40,000 to 60,000	5,000	— —	At bottom; when heated may stratify at points above bottom.	Products of combustion, sewer gas, sludge. Also issues from carbonaceous strata.	Oxygen deficiency indicator
Carbon Monoxide	CO	Chemical asphyxiant. Colorless, odorless, tasteless. Flammable. Poisonous.	0.97	Combines with hemoglobin of blood. Unconsciousness in 30 min. at 0.2% to 0.25%. Fatal in 4 hours at 0.1%. Headache in few hours at 0.02%.	400	50	12.5 74.0	Near top, especially if present with illuminating gas.	Manufactured gas, flue gas, products of combustion, motor exhausts. Fires of almost any kind.	CO ampoules.
Carbon Tetra-Chloride	CCl_4	Heavy, ethereal odor.	5.3	Intestinal upset, loss of consciousness, possible renal damage, respiratory failure.	1,000 to 1,500	100	— —	At bottom.	Industrial wastes, solvent, cleaning	Detectable odor at low concentrations.
Chlorine	Cl_2	Irritant. Yellow-green color. Choking odor detectable in very low concentrations. Non-flammable.	2.49	Irritates respiratory tract. Kills most animals in a very short time at 0.1%.	4	1	— —	At bottom.	Chlorine cylinder and feed line leaks.	Detectable odor at low concentrations.
Formaldehyde	CH_2O	Colorless, pungent suffocating odor.	1.07	Irritating to the nose.	—	10	7.0 73.0	Near bottom.	Incomplete combustion of organics. Common air pollutant, fungicide.	Detectable odor.
Gasoline	C_5H_{12} to C_9H_{20}	Volatile solvent. Colorless. Odor noticeable at 0.03%. Flammable.	3.0 to 4.0	Anesthetic effects when inhaled. Rapidly fatal at 2.4%. Dangerous for short exposure at 1.1 to 2.2%.	4,000 to 7,000	1,000	1.3 6.0	At bottom.	Service stations, garages, storage tanks, houses.	1. Combustible gas indicator. 2. Oxygen deficiency indicator.**
Hydrogen	H_2	Simple asphyxiant. Colorless, odorless, tasteless. Flammable	0.07	Acts mechanically to deprive tissues of oxygen. Does not support life.	—	—	4.0 74.0	At top.	Manufactured gas, sludge digestion tank gas, electrolysis of water. Rarely from rock strata.	Combustible gas indicator.
Hydrogen Cyanide	HCN	Faint odor of bitter almonds. Colorless gas	0.93	Slight symptoms appear upon exposure to 0.002% to 0.004%. 0.3% rapidly fatal.	—	10	6.0 40.0	Near top.	Insecticide and rodenticide.	Detector tube

Table C-1 Hazardous Gases (Continued)

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air =1	Physiological Effect	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air = 1	Physiological Effect*	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air.) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Hydrogen Sulfide	H_2S	Irritant and poisonous volatile compound. Rotten egg odor in small concentrations. Exposure for 2 to 15 min. at 0.01% impairs sense of smell. Odor not evident at high concentrations. Colorless. Flammable.	1.19	Impairs sense of smell, rapidly as concentration increases. Death in few minutes at 0.2%. Exposure to 0.07 to 0.1% rapidly causes acute poisoning. Paralyzes respiratory center.	200 to 300	20	4.3 45.0	Near bottom, but may be above bottom if air is heated and highly humid.	Coal gas, petroleum, sewer gas. Fumes from blasting under some conditions. Sludge gas.	1. H_2S Ampoule. 2. 5% by weight lead acetate solution.
Methane	CH_4	Simple asphyxiant. Colorless, odorless, tasteless, flammable.	0.55	Acts mechanically to deprive tissues of oxygen. Does not support life.	Probably no limit, provided oxygen percent-age is sufficient for life.	—	5.0 15.0	At top, increasing to certain depth.	Natural gas, sludge gas, manufactured gas, sewer gas. Strata of sedimentary origin. In swamps or marshes.	1. Combustible gas indicator 2. Oxygen deficiency indicator.
Nitrogen	N_2	Simple asphyxiant. Colorless, tasteless. Non-flammable. Principal constituent of air. (about 79%).	0.97	Physiologically inert.	—	—	— —	Near top, but may be found near bottom.	Sewer gas. sludge gas. Also issues from some rock strata.	Oxygen deficiency indicator.
Nitrogen Oxides	NO N_2O NO_2	Colorless Colorless, sweet odor. Reddish-brown. Irritating odor. Deadly poison	1.04 1.53 1.58	60 to 150 ppm cause irritation and coughing. Asphyxiant. 100 ppm dangerous. 200 ppm fatal.	50	10	— —	Near bottom.	Industrial wastes. Common air pollutant.	NO_2 detector tube.
Oxygen	O_2	Colorless, odorless, tasteless. Supports combustion.	1.11	Normal air contains 20.8% of O_2. Man can tolerate down to 12%. Minimum safe 8 hour exposure, 14 to 16%. Below 10%, dangerous to life. Below 5 to 7% probably fatal.	—	—	— —	Variable at different levels.	Oxygen depletion from poor ventilation and absorption, or chemical consumption of oxygen.	Oxygen deficiency indicator.
Ozone	O_3	Irritant and poisonous. Strong electrical odor. Strong oxidizer. Colorless. At 1 ppm, strong sulfur-like odor.	1.66	Max. naturally occurring level is 0.04 ppm. 0.05 ppm causes irritation of eyes and nose. 1 to 10 ppm causes headache, nausea; can cause coma. Symptoms similar to radiation damage.	0.08	0.04	— —	Near bottom.	Where ozone is used for disinfection.	Detectable odor at 0.015 ppm.

Table C-1 Hazardous Gases (Continued)

Gas	Chemical Formula	Common Properties	Specific Gravity or Vapor Density Air =1	Physiological Effect	Max Safe 60 Min. Exposure ppm	Max. Safe 8 Hour Exposure ppm	Explosive Range (% by vol. in air) Limits lower/upper	Likely Location of Highest Concentration	Most Common Sources	Simplest and Cheapest Safe Method of Testing
Sludge Gas	—***	Mostly a simple asphyxiant. May be practically odorless, tasteless.	Variable	Will not support life.	No data. Would vary widely with composition.		5.3 19.3	Near top of structure.	From digestion of sludge.	See components.
Sulfur Dioxide	SO_2	Colorless, pungent odor. Suffocating, corrosive, poisonous, non-flammable.	2.26	Inflammation of the eyes. 400 to 500 ppm immediately fatal.	50 to 100	10	— —	At bottom, can combine with water to form sulfurous acid.	Industrial waste, combustion, common air pollutant.	Detectable taste and odor at low concentration.
Toluene	C_5H_{12} to C_9H_{20}	Colorless, benzene-like odor.	3.14	At 200-500 ppm, headache, nausea, bad taste, lassitude.	200	100	1.27 7.0	At bottom.	Solvent.	Combustible gas indicator.
Turpentine	$C_{10}H_{16}$	Colorless, Characteristic odor.	4.84	Eye irritation. Headache, dizziness, nausea, irritation of the kidneys.	—	100		At bottom.	Solvent, used in paint.	1. Detectable odor at low concentrations. 2.Combustible gas indicator.
Xylene	C_8H_{10}	Colorless, flammable	3.66	Narcotic in high concentrations. less toxic than benzene.	—	100	1.1 7.0	At bottom.	Solvent	Combustible gas indicator.

* Percentages shown represent volume of gas in air.
** For concentration over 0.3%.
***Mostly methane and carbon dioxide with small amounts of hydrogen, nitrogen, hydrogen sulfide, and oxygen; occasionally traces of carbon monoxide.

3710 Portable Samplers

Appendix D Display Index

> **Note**
>
> To access the display number, press the STOP key while the sampler displays the screen in question. The display numbers are available in the Standby and Program states.

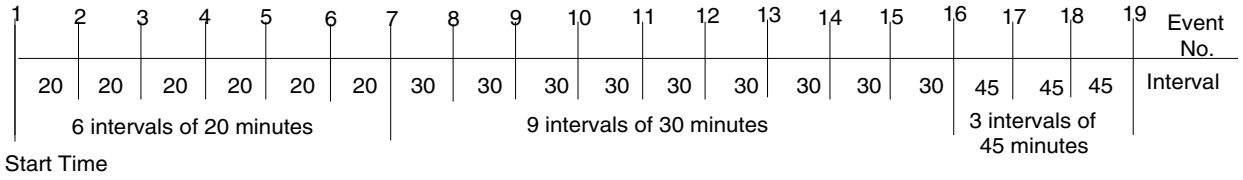
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Event No.
20 20 20 20 20 20 30 30 30 30 30 30 30 30 30 45 45 45
Interval
6 intervals of 20 minutes
9 intervals of 30 minutes
3 intervals of 45 minutes
Start Time

Figure D-1 Time Line

Table D-1 Display Index

This display appears after you press the ENTER/PROGRAM key while in standby. Select "PROGRAM" to access the program sequence. Select "CONFIGURE" to access the configure sequence.

Display 1

```
[PROGRAM, CONFIGURE]
      SAMPLER
```

This informational display appears when you stop the pump with the STOP key after pressing the PUMP FORWARD key. It reports the number of pump counts detected while the pump was in operation. Exit this display by pressing any key except STOP and ON/OFF.

Display 3

```
----- COUNTS FORWARD
```

This informational display appears when you stop the pump with the STOP key after having pressed the PUMP REVERSE key. It reports the number of pump counts detected while the pump was in operation. Exit this display by pressing any key except STOP and ON/OFF.

Display 3

```
----- COUNTS REVERSE
```

This display appears after you select "PROGRAM" in Display #1. Select "TIME" for time-paced sampling, "FLOW" for flow-paced sampling.

Display 10

```
    [TIME, FLOW]
PACED SAMPLING
```

Table D-1 Display Index (Continued)

This display appears only in the extended programming mode and follows Display #10 when you have selected "TIME." Select "UNIFORM" for uniform time intervals, "NONUNIFORM" for nonuniform time intervals.

Display11

```
[UNIFORM, NONUNIFORM]
   TIME INTERVALS
```

This display follows Display #11 when you have selected "NONUNIFORM." Select "YES" to modify the existing non-uniform intervals. Select "NO" to leave the nonuniform intervals unchanged.

Display 20

```
   MODIFY SEQUENCE?
      [YES, NO]
```

In the basic programming mode, this display appears after you have selected "TIME" in Display #10. In the extended programming mode, this display appears when you have selected "UNIFORM" in Display #11. Enter the uniform time interval. You need to make 2 entries: The first entry sets the hours, the second sets the minutes.

Display 21

```
      SAMPLE EVERY
 -- HOURS -- MINUTES
```

This display follows Display #10 when you have selected "FLOW." Enter the flow-pulse interval.

Display 22

```
      SAMPLE EVERY
---- PULSES (1 - 9999)
```

This display follows Display #15. Use this display to enter the number of timed sample events in a storm program.

Display 23

```
     TAKE -- TIMED
SAMPLE EVENTS (1 - MAX)
```

This display follows Display #23. Enter the time interval between time-paced sample events in a storm program.

Display 24

```
  SAMPLE INTERVALS OF
  -- MINUTES (1 - 99)
```

This display follows Display #20 when you select "YES" to modify the nonuniform time-interval sequence. Enter the number of sample events to occur at nonuniform time intervals. MAX varies according to the bottle size entered in Display #223

Display 25

```
   TAKE --- SAMPLES
      (1 - MAX)
```

This display follows Display #25. Enter the nonuniform clock times and dates for each sample event.

Display 26

```
    TAKE SAMPLES AT
1.  HH:MM       DD-MMM
```

Enter the number of samples to be taken at each interval. The total quantity you enter will be 1 fewer than the total number of samples, because the first sample, taken at the start time, counts as 1. For example, if you want to take 19 samples (the first 6 at 20-minute intervals, the next 9 at 30-minute intervals, and the remaining 3 at 45-minute intervals), first enter a quantity of 6 at 20 minutes, 9 at 30 minutes, and 3 at 45 minutes. Figure D-1 shows a time line for the sampling routine.

```
 QUANTITY AT INTERVAL
 1. -- AT --- MINUTES)
```

Enter the size of the sample volume. *MAX* will vary according to the number of samples.

Display 50

```
   SAMPLE VOLUMES OF
--- ml EACH  (10 - MAX)
```

Enter the number of composite samples. An entry of "0" instructs the sampler to take samples until a float shut-off terminates the sampling routine.

Display 60

```
     --- COMPOSITE
   SAMPLES (0 - MAX)
```

Table D-1 Display Index (Continued)

This display appears when you select "YES" in Display #242 or select "DISABLE" in Display #240. Enter the measured suction head. *MAX* will be the smaller of the suction line length or "20."

Display 70

```
SUCTION HEAD OF
-- FEET (1 - MAX)
```

This display appears in the program sequence when you have selected "ENABLE" in Display #290. Select "YES" to use the calibration sequence, "NO" to omit the calibration sequence.

Display 80

```
CALIBRATE SAMPLE
VOLUME?  [YES, NO]
```

This display is part of the calibration sequence. Press the MANUAL SAMPLE key when a collection bottle is underneath the pump tube and the suction line is in place.

Display 81

```
PRESS MANUAL SAMPLE
KEY WHEN READY...
```

This display is part of the calibration sequence. When it first appears, it reports the programmed sample volume. If the measured volume differs from the reported volume, enter the measured volume here.

Display 82

```
--- ml VOLUME
DELIVERED
```

This display is part of the calibration sequence and appears if the measured volume and the programmed volume differ by a factor of two or more. Select "YES" to confirm the number entered in Display #82. Select "NO" to return to Display #82.

Display 83

```
---ml! ARE YOU
SURE? [YES, NO]
```

Select "YES" to enter a start time. "NO" will begin the sampling routine according to the delay set in Display #310.

Display 90

```
ENTER START TIME?
[YES, NO]
```

This display appears when you have selected "YES" in Display #90. Enter the start time and date for the first sample event. This display will also appear if you have initiated the routine after a programmed start time so that you can reprogram the start time.

Display 91

```
TAKE FIRST SAMPLE AT
HH:MM DD-MMM
```

This display appears when you have selected "YES" in Display #90. Enter the start time and date for the flow -pulse countdown. This display will also appear if you have initiated the routine after a programmed start time so that you can reprogram the start time.

Display 92

```
START FLOW COUNT AT
HH:MM DD-MM
```

This display appears when you select "ENABLE" in Display #300. Enter the number of stop and resume times.

Display 100

```
-- STOP or RESUME
TIMES  (0 - 24)
```

This display appears when the setting in Display #100 is greater than zero. Enter the appropriate stop time.

Display 101

```
STOP SAMPLING AT
1.HH:MMDD-MMM
```

This display appears when the setting in Display #100 is greater than one. It follows Display #101. Enter the appropriate resume time.

Display 102

```
RESUME SAMPLING AT
1.HH:MMDD-MMM
```

Table D-1 Display Index (Continued)

This display appears when a routine is halted and you press the start sampling key. Select “START” to start the sampling program at the beginning, “RESUME” to continue the sampling program at the point at which it was halted.

Display 140

```
[START, RESUME]
SAMPLING PROGRAM
```

This display appears when you have started a routine after the programmed start time. Select “YES” to enter a new start time. Select “NO” to start the routine immedieately; some sample events may be missed or late.

Display 142

```
CHANGE START TIME?
[YES, NO]
```

This display appears after you press the display status key. Select “REVIEW” to view the summary of the current program settings and for sampling results. Select “PRINT” to send the current status, program settings, and sampling results to an Isco Field Printer. NOTE: The Teledyne Isco Field Printer is no longer sold, but this function remains available for customers who still have Field Printers. The printed results include data for sample events completed when you pressed the display status key.

Display 148

```
[REVIEW, PRINT] PROGRAM
      INFORMATION
```

This display appears after you select “Print” in Display #148. Select “NO” to return to standby. Select “Settings” to print the settings report. Select “RESULTS” to print the results report.

Display 149

```
PRINT PROGRAM [NO,
SETTINGS, RESULTS]
```

This display appears after you select “REVIEW” in Display #148. Select “NO” to return to the previous operating state. Select “SETTINGS” to view the summary of the current program settings. Select “RESULTS” to view the sampling results for sample events completed at the time you pressed the display status key.

Display 150

```
REVIEW PROGRAM [NO,
SETTINGS, RESULTS]
```

Display #151 is used to identify the displays used to summarize the current program settings which appear when you select “SETTINGS” in Display #150.

Display 151

```
SETTINGS DISPLAYS
```

Display #152 identifies sampling results displays that appear when you select “RESULTS” in Display #150.

Display 152

```
RESULTS DISPLAYS
```

Display #200 is used to identify the displays, which locate each configure option in the configure sequence. Press ENTER/PROGRAM to access the input displays for each option. Use the LEFT ARROW and the RIGHT ARROW keys to move through the options.

Display 200

```
SELECT OPTION (← →)
name of configure option
```

Set Clock configure option. Enter the time and date to set the controller's clock. Use military time. Enter two digits each for the day (DD), month (MM), and year (YY).

Display 210

```
HH:MM DD/MM/YY
HH:MM DD/MM/YY
```

Bottles and Sizes configure option. Select “PORTABLE” when you are using a 3710 Compact or Standard Sampler. Select REFRIG only if you have a refrigerated base unit.

Display 220

```
[PORTABLE, REFRIG]
      SAMPLER
```

Bottle and Size configure option. Enter the bottle volume in milliliters.

Display 223

```
BOTTLE VOLUME IS
------ ml
```

Table D-1 Display Index (Continued)

Bottle and Size configure option. This display appears when you have entered a bottle volume in Display #223 that exceeds a standard Teledyne Isco bottle size.

Display 224

```
---- ml ... ARE YOU
SURE? [YES, NO]
```

Suction Line configure option. Select "1/4" if you are using 1/4-inch suction line, "3/8" if you are using 3/8-inch suction line.

Display 230

```
SUCTION LINE ID IS
[1/4, 3/8] INCH
```

Suction Line configure option. This display appears when you have selected "3/8" in Display #230. Select "VINYL" if you are using vinyl suction line, "PTFE" if you are using PTFE suction line.

Display 231

```
SUCTION LINE IS
[VINYL, PTFE]
```

Suction Line configure option. Enter the length of the suction line. Do not include the tube coupling or the strainer in the length measurement.

Display 232

```
SUCTION LINE LENGTH
IS -- FEET (3 - 99)
```

Liquid Detector configure option. Select "ENABLE" to turn on the Liquid Detector, "DISABLE" to turn off the Liquid Detector. If you turn off the detector, you must enter the suction head (Display #70) in the program sequence.

Display 240

```
[ENABLE, DISABLE]
LIQUID DETECTOR
```

Liquid Detector configure option. This display appears when you select "ENABLE" in Display #240. Enter the number of rinse cycles. Rinse cycles condition the suction line to reduce cross-contamination.

Display 241

```
RINSE CYCLES (0 - 3)
```

Liquid Detector configure option. This display appears when you select "ENABLE" in Display #240. Select "YES" to add the suction-head setting (Display #70) to the program sequence. Select "NO" to omit the setting.

Display 242

```
ENTER HEAD MANUALLY?
[YES, NO]
```

Liquid Detector configure option. This display appears when you select "ENABLE" in Display #240. Enter the number of retries: the number of times the sampler will try to detect the presence of liquid for each sample event.

Display 243

```
RETRY UP TO - TIMES
WHEN SAMPLING (0 - 3)
```

Programming Mode configure option. Select "BASIC" to use the basic programming mode. To use the extended programming mode, select "EXTENDED."

Display 250

```
[BASIC, EXTENDED]
PROGRAMMING MODE
```

Load Stored Program configure option. Select the sampling program you want to use. Select "NONE" to exit the display without loading a program.

Display 255

```
LOAD PROGRAM
[#1, #2, #3, NONE]
```

Save Current Program configure option. Select the number with which you want to use to identify the current program when saved. Select "NONE" to exit the display without saving a program.

Display 260

```
SAVE PROGRAM AS
[#1, #2, #3, NONE]
```

Table D-1 Display Index (Continued)

Flow Mode Sampling configure option. This setting affects flow-paced sampling routines. Select "YES" to take the first sample at the start time, "NO" to take the first sample at the end of the first flow-pulse interval.

Display 270

```
TAKE SAMPLE AT START
  TIME? [YES, NO]
```

Nonuniform Time configure option. Select "CLOCK TIME" to enter the nonuniform time intervals as clock times (Display #26). Select "MINUTES" to set the nonuniform intervals in minutes (Display #27).

Display 280

```
ENTER INTERVALS IN
[CLOCK TIME, MINUTES]
```

Calibrate Sampler configure option. Select "ENABLE" to add calibration displays to the program sequence. Select "DISABLE" to omit the calibration displays.

Display 290

```
[ENABLE, DISABLE]
CALIBRATE SAMPLE
```

Sampling Stop/Resume configure option. Select "ENABLE" to add the Sampling Stop/Resume settings to the program sequence. Select "DISABLE" to omit the settings.

Display 300

```
[ENABLE, DISABLE]
SAMPLING STOP/RESUME
```

Sampling Stop/Resume configure option. This display appears when you select "ENABLE" in Display #300. Select "YES" to take a sample at stop times. Select "NO" if you do not want a sample event at the stop times.

Display 301

```
SAMPLE AT STOP?
   [YES, NO]
```

Sampling Stop/Resume configure option. This display appears when you select "ENABLE" in Display #300. Select "YES" to take a sample at the resume times. Select "NO" if you do not want a sample event at the resume times.

Display 302

```
SAMPLE AT RESUME?
   [YES, NO]
```

Start Time Delay configure option. Enter the amount of time, in minutes, you want to delay the start time. This entry affects programs that do not have a programmed start time.

Display 310

```
---- MINUTE DELAY
TO START  (0 - 9999)
```

Enable Pin configure option. Select "YES" to turn the Master/slave mode on. Select "NO" to turn the Master/Slave mode off.

Display 320

```
MASTER/SLAVE MODE?
   [YES, NO]
```

Enable Pin configure option. Select "YES" to take a sample at the time the sampler becomes disabled. Select "NO" if you do not want a sample event when the sampler becomes disabled.

Display 321

```
SAMPLE UPON DISABLE?
   [YES, NO]
```

Enable Pin configure option. Select "YES" to take a sample when the sampler becomes enabled; *i.e.,* ceases to receive an inhibit signal from a flow meter or a Liquid Level Actuator. Note: No sample will be taken if the enable signal is used to initiate the start-time delay countdown. Select "NO" if you do not want a sample event when the sampler becomes enabled.

Display 322

```
SAMPLE UPON ENABLE?
   [YES, NO]
```

Enable Pin configure option. Select "YES" to restart the sample interval countdown at the time the sampler is enabled. The interval countdown is determined by the setting if "NO" is selected in Display #324.

Display 323

```
   RESET SAMPLE
INTERVAL? [YES, NO]
```

Table D-1 Display Index (Continued)

Enable Pin configure option. This display appears if you select “NO” in Display #323. Select “YES” to freeze the sample interval when the sampler becomes disabled. When the sampler is enabled, the interval countdown continues from the point where it had stopped. Select “NO” to let the sample interval countdown continue while the sampler is disabled.

Display 324

```
INHIBIT COUNTDOWN?
[YES, NO]
```

Event Mark configure option. Select “CONTINUOUS SIGNAL” to send a variable-duration event mark signal from pin E of the flow meter connector. Select “PULSE” to send a 3-second event mark signal.

Display 330

```
[CONTINUOUS SIGNAL,
PULSE]
```

Event Mark configure option. This setting appears when you select “CONTINUOUS SIGNAL” in Display #330. Select “PUMP CYCLE” to transmit the event mark signal during the entire pump cycle, including any programmed rinses and retries. Select “FWD PUMPING ONLY” to send the signal when the pump is delivering a sample volume only.

Display 331

```
DURING [PUMP CYCLE,
FWD PUMPING ONLY]
```

Event Mark configure option. This setting appears when you select “PULSE” in Display #330. Select “PURGE” to transmit an event mark signal to a flow meter at the beginning of the pre-sample purge. Select “FWD PUMPING” to transmit a signal when the pump switches forward to deliver the sample volume.

Display 332

```
AT THE BEGINNING OF
[PURGE, FWD PUMPING]
```

Purge Counts configure option. Enter the number of pre-sample pump counts needed to purge the suction line. This value is set to 150 when the controller is reinitialized.

Display 340

```
--- PRE-SAMPLE
COUNTS (0 - 9999)
```

Purge Counts configure option. Enter the number of post-sample pump counts needed to purge the suction line. The Controller derives the number that initially appears in this display from the suction line ID and length entered in Display #230 and #232.

Display 341

```
--- POST-SAMPLE
COUNTS (0 - 9999)
```

Tubing Life configure option. This informational display communicates the pump counts elapsed since the last reset and the counts required to trigger the Pump Tubing Warning. Exit this display by pressing any key.

Display 350

```
------- PUMP COUNTS,
WARNING AT -------
```

Tubing Life configure option. After changing the pump tube, select “YES” to reset the pump counter to zero. Select “NO” to leave the counter unchanged.

Display 351

```
--- POST-SAMPLE
COUNTS (0 - 9999)
```

Tubing Life configure option. Enter the number of pump counts required to trigger the pump-count warning if the factory setting is not suitable. This value is set to 500,000 when the controller is reinitialized.

Display 352

```
------- PUMP COUNTS
TO WARNING
```

Program Lock configure option. Select “ENABLE” to turn on the program lock. If you enable the program lock, input displays are protected by a pass-number: 3700. The controller will not allow you to make any changes to a program or configure sequence setting until you enter the pass-number when requested. Select “DISABLE” to turn the program lock off.

Display 360

```
[ENABLE, DISABLE]
PROGRAM LOCK
```

Table D-1 Display Index (Continued)

Sampler ID configure option. Enter the sampler identification here. The sampler will accept as many as 10 characters, including periods (press resume sampling), dashes (press manual sample), and spaces (press start sampling).

Display 365

```
SAMPLER ID NUMBER IS
__________
```

Run Diagnostics configure option. Select “YES” to “reinitialize” (reset) the controller: the entire RAM – with the exception of the configure option settings for current pump-count total, number of bottles, bottle size, suction-line length, and sampler ID – will be reset to factory settings. Select “NO” the leave the settings unchanged.

Display 371

```
RE-INITIALIZE?
[YES, NO]
```

3710 Portable Samplers

Appendix E Calculating Flow Increment Between Samples

The 3710 Sampler will accept flow-proportional inputs from an external flow meter or flow logger. These electronic flow-input signals are transmitted to the sampler at fixed increments of total flow, for example, every 10,000 gallons. Each time 10,000 gallons of liquid flows past the flow meter, it sends a signal to the sampler, which registers it as a single flow pulse. You can program the sampler to totalize any number of flow pulses from 1 to 9,999 before initiating a sampling event. For example, if the sampler were programmed to totalize 5 flow pulses and each flow pulse represented 10,000 gallons of total flow, a sample would be collected each time 50,000 gallons (5 flow pulses of 10,000 gallons each) had passed the flow meter.

Time Interval Known – If the desired average time interval between individual samples is known, the flow increment between samples can be determined by calculating how much flow (based on the average flow rate) occurs during that time interval. For example, assume that the average flow is 2.5 MGD and it is desired to collect a sample every 30 minutes. The flow increment between samples is calculated:

2.5 MGD = 2,500,000 GAL/DAY

2,500,000 GAL/DAY X 1 DAY/24 HR X 1 HR/60 MIN = 1736 GAL/MIN

736 GAL/MIN X 30 MIN/SAMPLE = 52,080 GAL/SAMPLE

Thus, the desired flow increment between samples is approximately 52,000 gallons.

Number of Samples Known – Alternatively, if the total number of samples to be collected over the total sampling period is known, the flow increment between samples can be determined by calculating how much total flow will occur during the sampling period, and dividing this by the total number of samples to be collected. For example, assume that the average flow is 1.75 MGD, that the composite sampling period is 2 days, and that it is desired to collect 100 individual samples. The flow increment between samples is calculated:

1.75 MGD = 1,750,000 GAL/DAY

1,750,000 GAL/DAY X 2 DAYS = 3,500,000 GAL

3,500,000 GAL ÷ 100 SAMPLES = 35,000 GAL/SAMPLE

Thus, the desired flow increment between samples is approximately 35,000 gallons.

Calculation of Number of Flow Pulses – Once the desired flow increment between samples is known, the number of flow pulses to be programmed into the sampler may be calculated, assuming that the volume of the flow pulses from the flow meter is known. The number of flow pulses is calculated by dividing the flow increment between samples by the volume of each flow pulse. Using the first example above, the flow increment between samples was calculated as 52,000 gallons; assume that each flow pulse represents 10,000 gallons of flow. The number of flow pulses to be programmed into the sampler is calculated:

52,000 GAL ÷ 10,000 GAL/FLOW PULSE = 5.2 FLOW PULSES

Rounding this to an even number results in 5 flow pulses to be programmed into the sampler. This in turn results in a flow increment between samples of 50,000 gallons (5 flow pulses × 10,000 gallons/flow pulse).

Total Number Of Samples – To calculate the total number of samples to be collected, three quantities must be known: the average flow rate, the flow increment between samples (calculated above), and the total time over which the composite sample is to be collected. The total number of samples to be collected is determined by first calculating the total flow volume over the sampling period, and then dividing this by the flow increment between samples. For example, assume that the average flow is 2.5 MGD, the flow increment between samples is 50,000 gallons, and the composite sample is to be collected over a 24 hour period. The total flow volume over a 24 hour period is:

2.5 MGD = 2,500,000 GAL/DAY

2,500,000 GAL/DAY X 1 DAY = 2,500,000 GAL

The total number of samples to be collected in this 24 hour period is then calculated:

2,500,000 GAL ÷ 50,000 GAL/SAMPLES = 50 SAMPLES

Thus, based on an average flow of 2.5 MGD, 50 samples will be collected.

Calculation of Sample Volume – To calculate the volume of each individual sample, the volume of the composite sample container being used and the total number of samples to be collected (calculated above) must be known. The individual sample volume is calculated by simply dividing the volume of the composite sample container being used by the total number of samples to be collected. For example, assume that a 2.5 gallon (9,400 ml) plastic container is being used, and that a total of 50 samples are to be collected in it. The individual sample volume is then calculated:

9400 ML ÷ 50 SAMPLES = 188 ML

Sample Volume Considerations – Thus, a sample volume of 188 ml will result in the desired composite sample. Because of the basic uncertainty of the delivered sample volume exactly matching the programmed nominal sample volume and the 10 ml sample repeatability, it is good practice to select a nominal sample volume which is slightly smaller than the calculated sample volume. This is to prevent overfilling of the sample container. In the example, an individual nominal sample volume of 125 ml might be a prudent choice. For critical applications, calibration of the sample volume can be used. It is important to select an individual sample volume which will not result in an overfilled sample container under worst-case conditions.

The nominal volume of the composite sample may be calculated by multiplying the programmed nominal sample volume by the total number of samples to be collected. In the example:

125 ML/SAMPLE X 50 SAMPLES = 6,250 ML

This calculated total volume may vary from the actual total volume because of variations in the actual volume of each individual sample. The total time needed to collect the 50 individual samples may vary from the desired 24 hour period because of variations in the average flow rate from the 2.5 MGD figure used in these calculations.

3710 Portable Samplers

Appendix F Glossary

Composite sampling – In composite sampling, multiple sample volumes are placed in bottle sets. Typically, composite sampling uses a single container. A composite sample represents an average of the characteristics of the flow stream for the elapsed time of sampling.

Controller – The controller, housed within the molded control box, is a collection of electronic components, which govern the actions of the sampler. It includes the microprocessor, RAM (Random Access Memory), ROM (Read Only Memory) and its imbedded software, the LCD (Liquid Crystal Display), and the keypad.

Cross contamination – Cross contamination occurs when portions of previous samples are mixed with the current sample. For example, cross contamination results when residual amounts of sample remain in the suction line or pump tube from a previous sample event.

Event mark – An event mark is a signal that the sampler sends to a flow meter or other device a each sample event. Each time the flow meter receives an event mark pulse, the flow meter places a mark on the its recording chart. Marking the recording chart cross-references the charted flow with the sample events.

Post-sample purge – Post-sample purge refers to the suction line purge that follows the delivery of the sample volume(s). It is also called post-purge.

Pre-sample purge – Pre-sample purge refers to the suction line purge that precedes the delivery of the sample volume(s). It is also called pre- purge.

Real-time clock – A real-time clock can be set to the actual time and date.

Sample event – A sample event consists of the complete sampling cycle resulting in the collection and distribution of one or more equal sample volumes. A sample event includes pre-sample and post-sample purges, line rinses, liquid detection retries, and deliveries of sample volumes. No more than one sample volume is placed in any one bottle during a sample event.

Sample volume – The sample volume is the discrete, programmed amount of sample delivered to each bottle. A single sample event may deliver several sample volumes.

Sampling routine – A sampling routine, also called a sampling program, is the process of taking samples according to the program settings you enter when programming and configuring the controller. The program settings define the sample pacing, distribution, volume, and key clock times.

Selection – A selection is represented by a blinking word or number in an input display. The blinking selection indicates the current choice or value. Selections are accepted and stored by pressing the enter/program key.

Suction head – Suction head is the vertical distance from the surface of the flow stream to the pump inlet.

3710 Portable Samplers

Appendix G Material Safety Data Sheets

This appendix provides Material Safety Data sheets for the internal desiccant used in the 3710 sampler.

Specific questions regarding the use and handling of these products should be directed to the manufacturer listed in the MSDS.

101 Christine Drive
Belen, New Mexico 87002
Phone: (505) 864-6691
Fax: (505) 861-2355

SÜD-CHEMIE
Performance Packaging

ISO 9002

MATERIAL SAFETY DATA SHEET -- September 28, 1998
SORB-IT®
Packaged Desiccant

SECTION I -- PRODUCT IDENTIFICATION

Trade Name and Synonyms:	Silica Gel, Synthetic Amorphous Silica, Silicon, Dioxide
Chemical Family:	Synthetic Amorphous Silica
Formula:	SiO_2.x H_2O

SECTION II -- HAZARDOUS INGREDIENTS

Components in the Solid Mixture

COMPONENT	CAS No	%	ACGIH/TLV (PPM)	OSHA-(PEL)
Amorphous Silica	63231-67-4	>99	PEL - 20 (RESPIRABLE), TLV – 5	LIMIT – NONE, HAZARD - IRRITANT ˝

Synthetic amorphous silica is not to be confused with crystalline silica such as quartz, cristobalite or tridymite or with diatomaceous earth or other naturally occurring forms of amorphous silica that frequently contain crystalline forms.

This product is in granular form and packed in bags for use as a desiccant. Therefore, no exposure to the product is anticipated under normal use of this product. Avoid inhaling desiccant dust.

SECTION III -- PHYSICAL DATA

Appearance and Odor:	White granules; odorless.
Melting Point:	>1600 Deg C; >2900 Deg F
Solubility in Water:	Insoluble.
Bulk Density:	>40 lbs./cu. ft.
Percent Volatile by Weight @ 1750 Deg F:	<10%.

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MATERIAL SAFETY DATA SHEET -- September 28, 1998
SORB-IT®
Packaged Desiccant

SECTION IV -- FIRE EXPLOSION DATA

Fire and Explosion Hazard - Negligible fire and explosion hazard when exposed to heat or flame by reaction with incompatible substances.

Flash Point - Nonflammable.

Firefighting Media - Dry chemical, water spray, or foam. For larger fires, use water spray fog or foam.

Firefighting - Nonflammable solids, liquids, or gases: Cool containers that are exposed to flames with water from the side until well after fire is out. For massive fire in enclosed area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of the tank due to fire.

SECTION V -- HEALTH HAZARD DATA

Health hazards may arise from inhalation, ingestion, and/or contact with the skin and/or eyes. Ingestion may result in damage to throat and esophagus and/or gastrointestinal disorders. Inhalation may cause burning to the upper respiratory tract and/or temporary or permanent lung damage. Prolonged or repeated contact with the skin, in absence of proper hygiene, may cause dryness, irritation, and/or dermatitis. Contact with eye tissue may result in irritation, burns, or conjunctivitis.

First Aid (Inhalation) - Remove to fresh air immediately. If breathing has stopped, give artificial respiration. Keep affected person warm and at rest. Get medical attention immediately.

First Aid (Ingestion) - If large amounts have been ingested, give emetics to cause vomiting. Stomach siphon may be applied as well. Milk and fatty acids should be avoided. Get medical attention immediately.

First Aid (Eyes) - Wash eyes immediately and carefully for 30 minutes with running water.

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MATERIAL SAFETY DATA SHEET -- September 28, 1998
SORB-IT®
Packaged Desiccant

NOTE TO PHYSICIAN: This product is a desiccant and generates heat as it adsorbs water. The used product can contain material of hazardous nature. Identify that material and treat accordingly.

SECTION VI -- REACTIVITY DATA

Reactivity - Silica gel is stable under normal temperatures and pressures in sealed containers. Moisture can cause a rise in temperature which may result in a burn.

SECTION VII --SPILL OR LEAK PROCEDURES

Notify safety personnel of spills or leaks. Clean-up personnel need protection against inhalation of dusts or fumes. Eye protection is required. Vacuuming and/or wet methods of cleanup are preferred. Place in appropriate containers for disposal, keeping airborne particulates at a minimum.

SECTION VIII -- SPECIAL PROTECTION INFORMATION

Respiratory Protection - Provide a NIOSH/MSHA jointly approved respirator in the absence of proper environmental control. Contact your safety equipment supplier for proper mask type.

Ventilation - Provide general and/or local exhaust ventilation to keep exposures below the TLV. Ventilation used must be designed to prevent spots of dust accumulation or recycling of dusts.

Protective Clothing - Wear protective clothing, including long sleeves and gloves, to prevent repeated or prolonged skin contact.

Eye Protection - Chemical splash goggles designed in compliance with OSHA regulations are recommended. Consult your safety equipment supplier.

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MATERIAL SAFETY DATA SHEET -- September 28, 1998
SORB-IT®
Packaged Desiccant

SECTION IX -- SPECIAL PRECAUTIONS

Avoid breathing dust and prolonged contact with skin. Silica gel dust causes eye irritation and breathing dust may be harmful.

* No Information Available

HMIS (Hazardous Materials Identification System) for this product is as follows:

Health Hazard	0
Flammability	0
Reactivity	0
Personal Protection	HMIS assigns choice of personal protective equipment to the customer, as the raw material supplier is unfamiliar with the condition of use.

The information contained herein is based upon data considered true and accurate. However, United Desiccants makes no warranties expressed or implied, as to the accuracy or adequacy of the information contained herein or the results to be obtained from the use thereof. This information is offered solely for the user's consideration, investigation and verification. Since the use and conditions of use of this information and the material described herein are not within the control of United Desiccants, United Desiccants assumes no responsibility for injury to the user or third persons. The material described herein is sold only pursuant to United Desiccants' Terms and Conditions of Sale, including those limiting warranties and remedies contained therein. It is the responsibility of the user to determine whether any use of the data and information is in accordance with applicable federal, state or local laws and regulations.

Material Safety Data Sheet

Indicating Silica Gel

Identity (Trade Name as Used on Label)

Manufacturer :	MULTISORB TECHNOLOGIES, INC. (formerly Multiform Desiccants, Inc.)	MSDS Number* :	M75
Address:	325 Harlem Road Buffalo, NY 14224	CAS Number* :	
Phone Number (For Information):	716/824-8900	Date Prepared:	July 6, 2000
Emergency Phone Number:	716/824-8900	Prepared By* :	G.E. McKedy

Section 1 - Material Identification and Information

Components - Chemical Name & Common Names (Hazardous Components 1% or greater; Carcinogens 0.1% or greater)	%*	OSHA PEL	ACGIH TLV	OTHER LIMITS RECOMMENDED
Silica Gel SiO_2	98.0	6mg/m^3 (total dust)	10mg/m^3 (total dust)	
Cobalt Chloride	>2.0	0.05mg/m^3 (TWA cobalt metal dust & fume)	.05mg/m^3 (Cobalt, TWA)	
Non-Hazardous Ingredients				
TOTAL	100			

Section 2 - Physical/Chemical Characteristics

Boiling Point	N/A	Specific Gravity (H_20 = 1)	2.1
Vapor Pressure (mm Hg and Temperature	N/A	Melting Point	N/A
Vapor Density (Air =1)	N/A	Evaporation Rate (_____=1)	N/A
Solubility in Water	Insoluble, but will adsorb moisture.	Water Reactive	Not reactive, but will adsorb moisture.
Appearance and Odor	Purple crystals, no odor.		

Section 3 - Fire and Explosion Hazard Data

Flash Point and Methods Used	N/A	Auto-Ignition Temperature	N/A	Flammability Limits in Air % by Volume	N/A	LEL	UEL
Extinguisher Media	Dry chemical, carbon dioxide and foam can be used.						
Special Fire Fighting Procedures	Water will generate heat due to the silica gel which will adsorb water and liberate heat.						
Unusual Fire and Explosion Hazards	When exposed to water, the silica gel can get hot enough to reach the boiling point of water. Flooding with water will reduce the temperature to safe limits.						

Section 4 - Reactivity Hazard Data

STABILITY ☐**Stable** ☐**Unstable**	Conditions To Avoid	Moisture and high humidity environments.
Incompatibility (Materials to Avoid)	Water.	
Hazardous Decomposition Products	Carbon dioxide, carbon monoxide, water	
HAZARDOUS POLYMERIZATION ☐May Occur	Conditions To Avoid	None.

*Optional

Section 5 - Health Hazard Data

PRIMARY ROUTES OF ENTRY	☐Inhalation ☐Skin Absorption	☐Ingestion ☐Not Hazardous	**CARCINOGEN LISTED IN**	☐NTP ☐IARC Monograph	☐OSHA ☐Not Listed
HEALTH HAZARDS	Acute	May cause eye, skin and mucous membrane irritation.			
	Chronic	Prolonged inhalation may cause lung damage.			
Signs and Symptoms of Exposure	Drying and irritation.				
Medical Conditions Generally Aggravated by Exposure	Asthma.				
EMERGENCY FIRST AID PROCEDURES - Seek medical assistance for further treatment, observation and support if necessary.					
Eye Contact	Flush with water for at least 15 minutes.				
Skin Contact	Wash affected area with soap and water.				
Inhalation	Remove affected person to fresh air.				
Ingestion	Drink at least 2 glasses of water.				

Section 6 - Control and Protective Measures

Respiratory Protection (Specify Type)	Use NIOSH approved dust mask or respirator.		
Protective Gloves	Light cotton gloves.	Eye Protection	Safety glasses.
VENTILATION TO BE USED	☐ Local Exhaust	☐Mechanical (General)	☐Special
	☐Other (Specify)		
Other Protective Clothing and Equipment	None.		
Hygienic Work Practices	Avoid raising dust. Avoid contact with skin, eyes and clothing.		

Section 7 - Precautions for Safe Handling and Use/Leak Procedures

Steps to be Taken if Material Is Spilled Or Released	Sweep or vacuum up and place the spilled material in a waste disposal container. Avoid raising dust.
Waste Disposal Methods	Dispose in an approved landfill according to federal, state and local regulations.
Precautions to be Taken In Handling and Storage	Cover promptly to avoid blowing dust. Wash after handling.
Other Precautions and/or Special Hazards	Keep in sealed containers away from moisture. The silica gel will readily adsorb moisture.

*Optional Indicating Silica Gel

3710 Portable Samplers

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产品中有毒有害物质或元素的名称及含量

Name and amount of Hazardous Substances or Elements in the product

部件名称 Component Name	有毒有害物质或元素 Hazardous Substances or Elements					
	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二联苯 (PBDE)
线路板 Circuit Boards	X	O	O	O	O	O
显示 Display	X	O	O	O	O	O
接线 Wiring	O	O	O	O	X	O
内部电缆 Internal Cables	O	O	O	O	X	O
主电源线 Line Cord	O	O	O	O	X	O
直流电机 DC Motor	X	O	O	O	X	O
小键盘 Keypad	O	O	O	O	X	O
接头 Connectors	O	O	X	O	O	O

产品中有毒有害物质或元素的名称及含量：Name and amount of Hazardous Substances or Elements in the product

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在ST/ 标准规定的限量要求以下。

O: Represent the concentration of the hazardous substance in this component's any homogeneous pieces is lower than the ST/ standard limitation.

X：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出ST/ 标准规定的限量要求。

(企业可在此处，根据实际情况对上表中打"X" 的技术原因进行进一步说明。)

X: Represent the concentration of the hazardous substance in this component's at least one homogeneous piece is higher than the ST/ standard limitation.

(Manufacturer may give technical reasons to the "X"marks)

环保使用期由经验确定。

The Environmentally Friendly Use Period (EFUP) was determined through experience.

生产日期被编码在系列号码中。前三位数字为生产年(207 代表 2007 年) 。随后的一个字母代表月份：A 为一月，B 为二月，等等。

The date of Manufacture is in code within the serial number. The first three numbers are the year of manufacture (207 is year 2007) followed by a letter for the month. "A" is January, "B" is February and so on.

DECLARATION OF CONFORMITY

ISM1-A

Application of Council Directive:	89/336/EEC – The EMC Directive 73/23/EEC – The Low Voltage Directive
Manufacturer's Name:	Teledyne Isco, Inc.
Manufacturer's Address:	4700 Superior, Lincoln, Nebraska 68504 USA Mailing Address: P.O. Box 82531, Lincoln, NE 68501
Equipment Type/Environment:	Laboratory Equipment for Light Industrial/Commercial Environments
Trade Name/Model No:	3710 sampler with 923 or 946 power source
Year of Issue:	1996
Standards to which Conformity is Declared:	EN 61326-1998 EMC Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use EN 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

Standard	Description	Severity Applied	Performance Criteria
EN61000-4-2	Electrostatic Discharge	Level 2 - 4kV contact discharge Level 3 - 8kV air discharge	A
EN61000-4-3	Radiated RF Immunity	80 MHz to 1000MHz 80% AM at 1kHz Level 1 - 10 V/m	A
EN61000-4-4	Electrical Fast Transient	Level 2 - 2kV on AC lines	A
EN61000-4-5	Surge on I/O Lines	2kV common mode, 1kV differential mode	A
EN61000-4-6	Conducted RF on AC lines	150 kHz to 80 MHz, 3V rms, 80% modulated	A
EN61000-4-11	Voltage Dips/Short Interruptions	0.5 cycle, each polarity/100%	A
CISPR11/ EN55011	RF Emissions	Group 1, Class A Industrial, Scientific, and Medical Equipment	
EN61000-3-2 3-3	Harmonic, Flicker		

We, the undersigned, hereby declare that the design of the equipment specified above conforms to the above Directive(s) and Standards as of April 25, 1996.

William Foster
USA Representative

TELEDYNE ISCO
A Teledyne Technologies Company

William Foster
Director of Engineering
Teledyne Isco, Inc.
4700 Superior Street
Lincoln, Nebraska 68504

Phone: (402) 464-0231
Fax: (402) 464-4543

60-3713-057
Rev C

*Teledyne Isco One Year Limited Factory Service Warranty **

Teledyne Isco warrants covered products against failure due to faulty parts or workmanship for a period of one year (365 days) from their shipping date, or from the date of installation by an authorized Teledyne Isco Service Engineer, as may be appropriate.

During the warranty period, repairs, replacements, and labor shall be provided at no charge. Teledyne Isco's liability is strictly limited to repair and/or replacement, at Teledyne Isco's sole discretion.

Failure of expendable items (e.g., charts, ribbon, tubing, lamps, glassware, seals, filters, fittings, and wetted parts of valves), or from normal wear, accident, misuse, corrosion, or lack of proper maintenance, is not covered. Teledyne Isco assumes no liability for any consequential damages.

This warranty does not cover loss, damage, or defects resulting from transportation between the customer's facility and the repair facility.

Teledyne Isco specifically disclaims any warranty of merchantability or fitness for a particular purpose.

This warranty applies only to products sold under the Teledyne Isco trademark and is made in lieu of any other warranty, written or expressed.

No items may be returned for warranty service without a return authorization number issued from Teledyne Isco.

The warrantor is Teledyne Isco, Inc.
4700 Superior, Lincoln, NE 68504, U.S.A.

*** This warranty applies to the USA and countries where Teledyne Isco Inc. does not have an authorized dealer. Customers in countries outside the USA, where Teledyne Isco has an authorized dealer, should contact their Teledyne Isco dealer for warranty service.**

In the event of instrument problems, always contact the Teledyne Isco Service Department, as problems can often be diagnosed and corrected without requiring an on-site visit. In the U.S.A., contact Teledyne Isco Service at the numbers listed below. International customers should contact their local Teledyne Isco agent or Teledyne Isco International Customer Service.

Return Authorization

A return authorization number must be issued prior to shipping. Following authorization, Teledyne Isco will pay for surface transportation (excluding packing/crating) both ways for 30 days from the beginning of the warranty period. After 30 days, expense for warranty shipments will be the responsibility of the customer.

Shipping Address: Teledyne Isco, Inc. - Attention Repair Service
4700 Superior Street
Lincoln NE 68504 USA

Mailing address: Teledyne Isco, Inc.
PO Box 82531
Lincoln NE 68501 USA

Phone: Repair service: (800)775-2965 (lab instruments)
(800)228-4373 (samplers & flow meters)
Sales & General Information (800)228-4373 (USA & Canada)

Fax: (402) 465-3001

Email: iscoservice@teledyne.com **Web site:** www.isco.com

February 1, 2006 P/N 60-1002-040 Rev C

TELEDYNE ISCO
A Teledyne Technologies Company